

The background of the slide is a photograph of a tall, ornate building tower, likely a clock tower, reaching into a blue sky with scattered white clouds. The tower has multiple levels with arched windows and a clock face visible on its side. The image is slightly faded to allow the text to be the primary focus.

Oil Transport along the Northern Coastline of the Gulf of Mexico

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Institute for Computational Engineering and Sciences
University of Texas at Austin

Lakeway Men’s Breakfast Club

Lakeway, Texas

07 December 2011

JC Dietrich, et al. (2011). “Surface Trajectories of Oil Transport along the Northern Coastline of the Gulf of Mexico.”
Continental Shelf Research, in review.

Who Are We?

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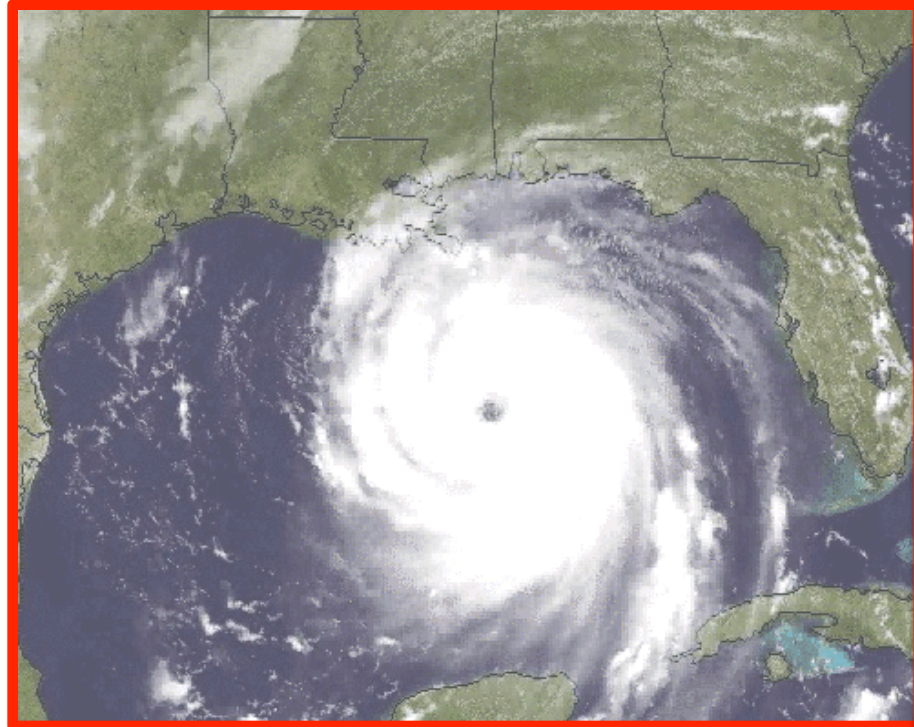
Dept. of Oceanography and Coastal
Sciences, Louisiana State University

RR Twilley

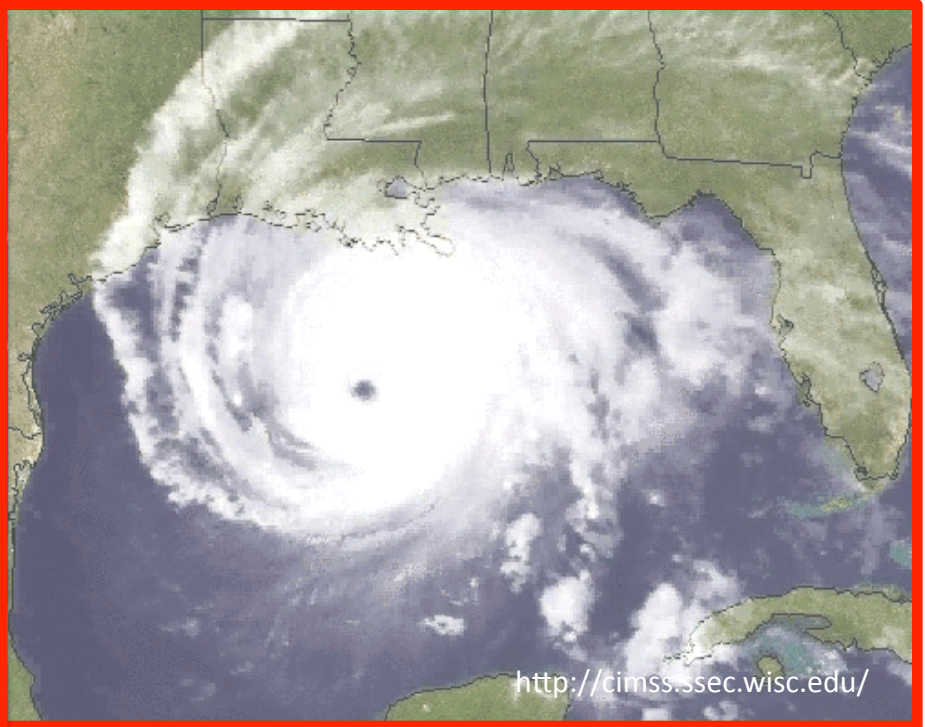
Vice President for Research,
University of Louisiana at Lafayette

Hurricane Waves and Storm Surge

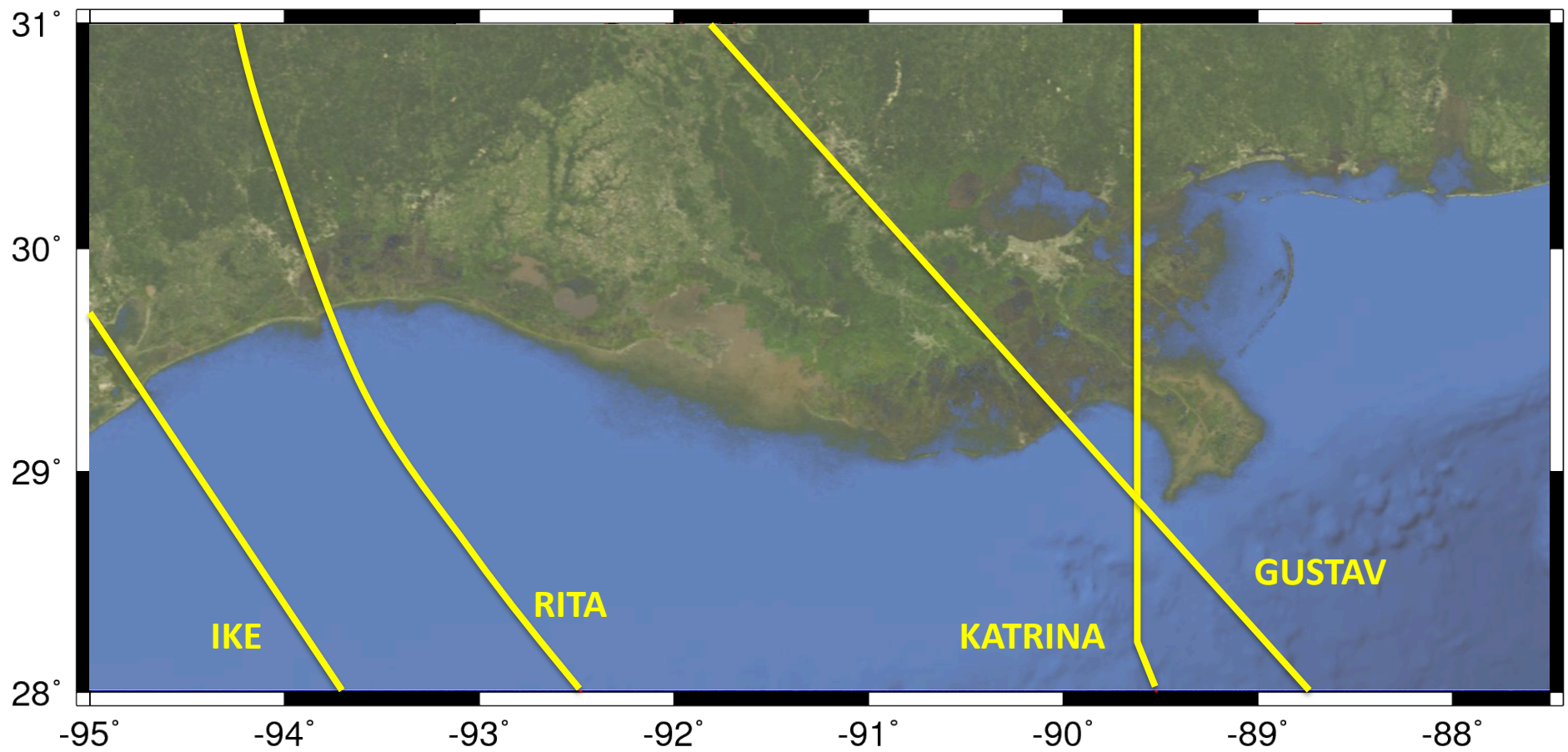
Katrina : 2005 / 08 / 28 – 29



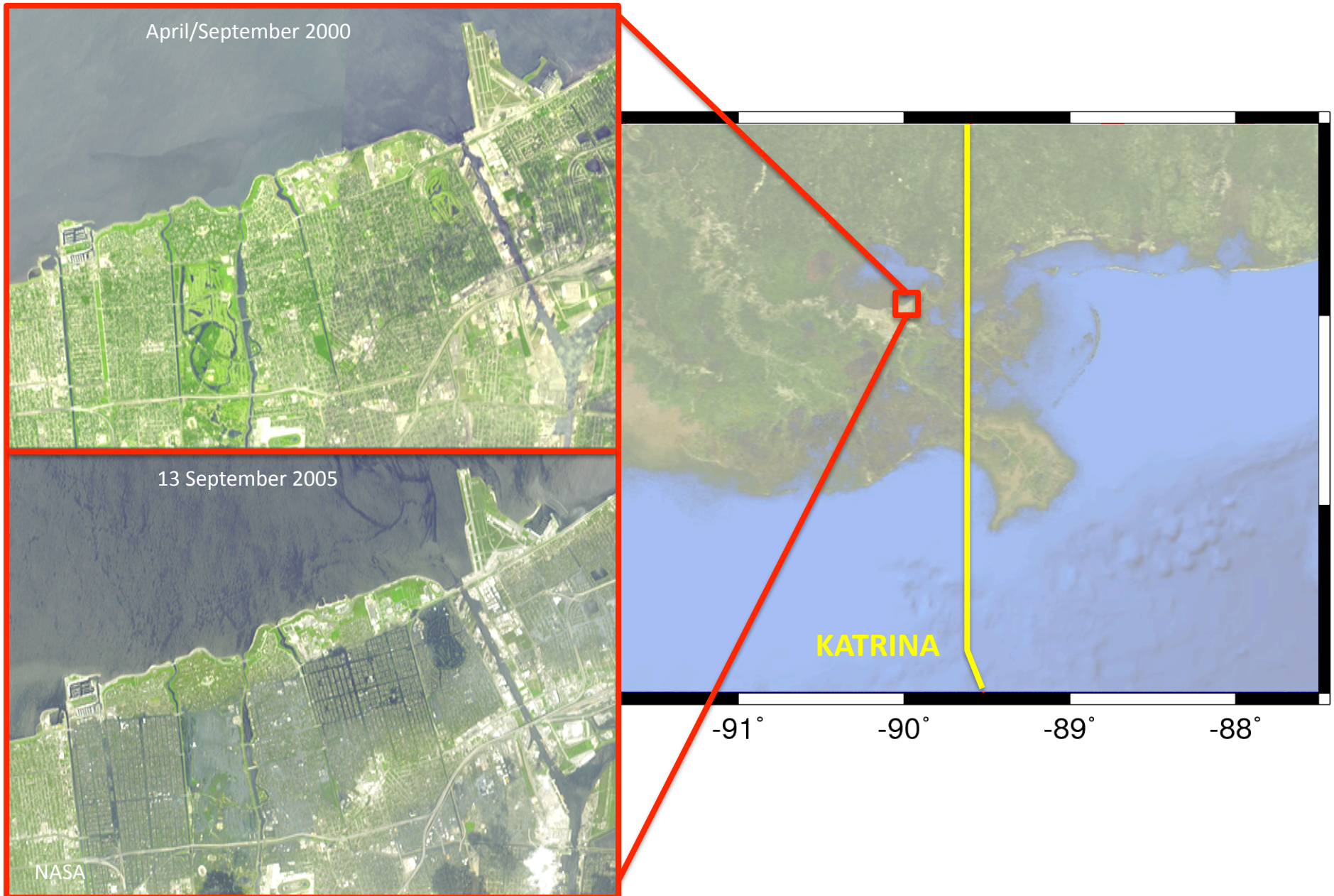
Rita : 2005 / 09 / 22 – 24



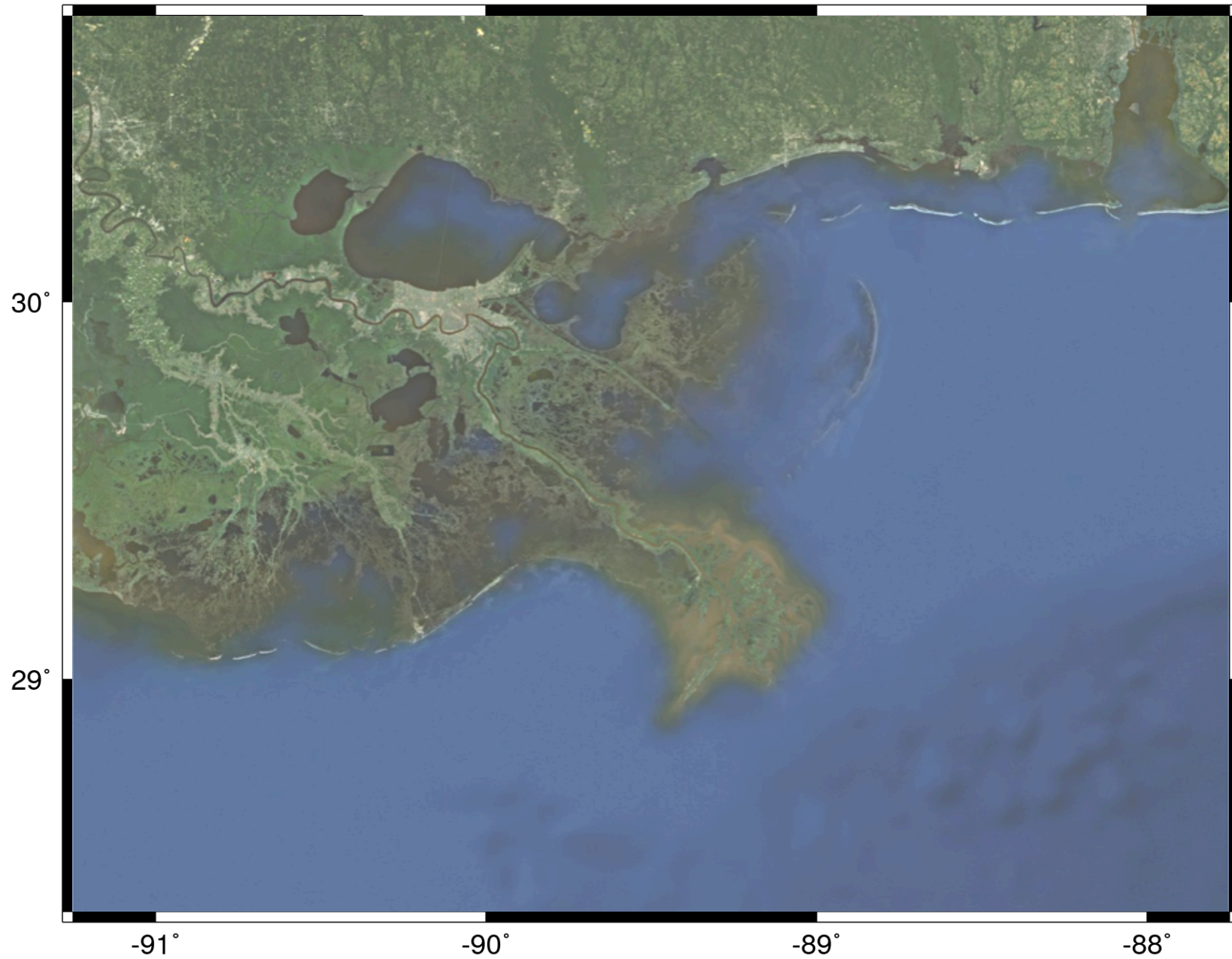
Hurricane Waves and Storm Surge



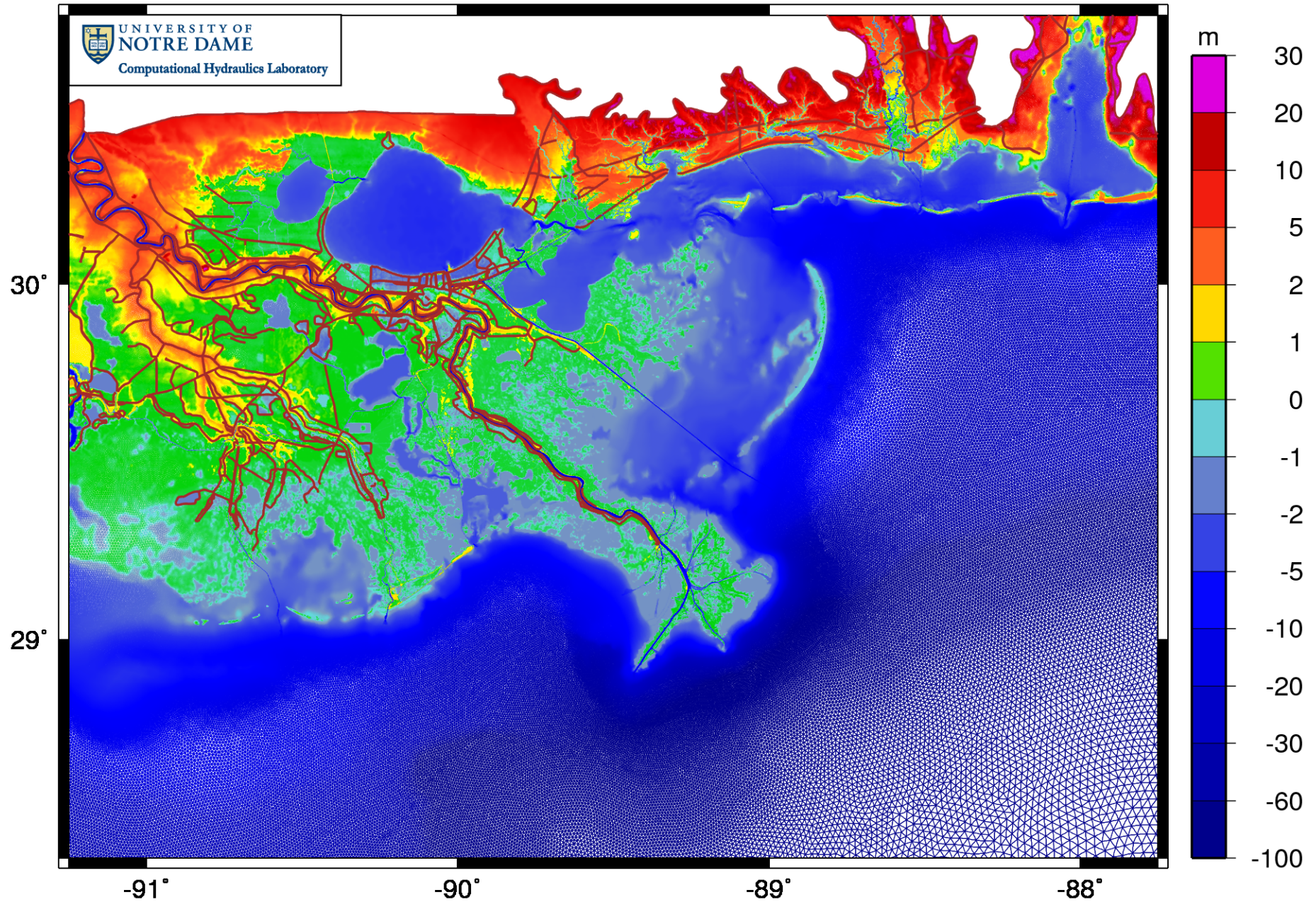
Hurricane Waves and Storm Surge



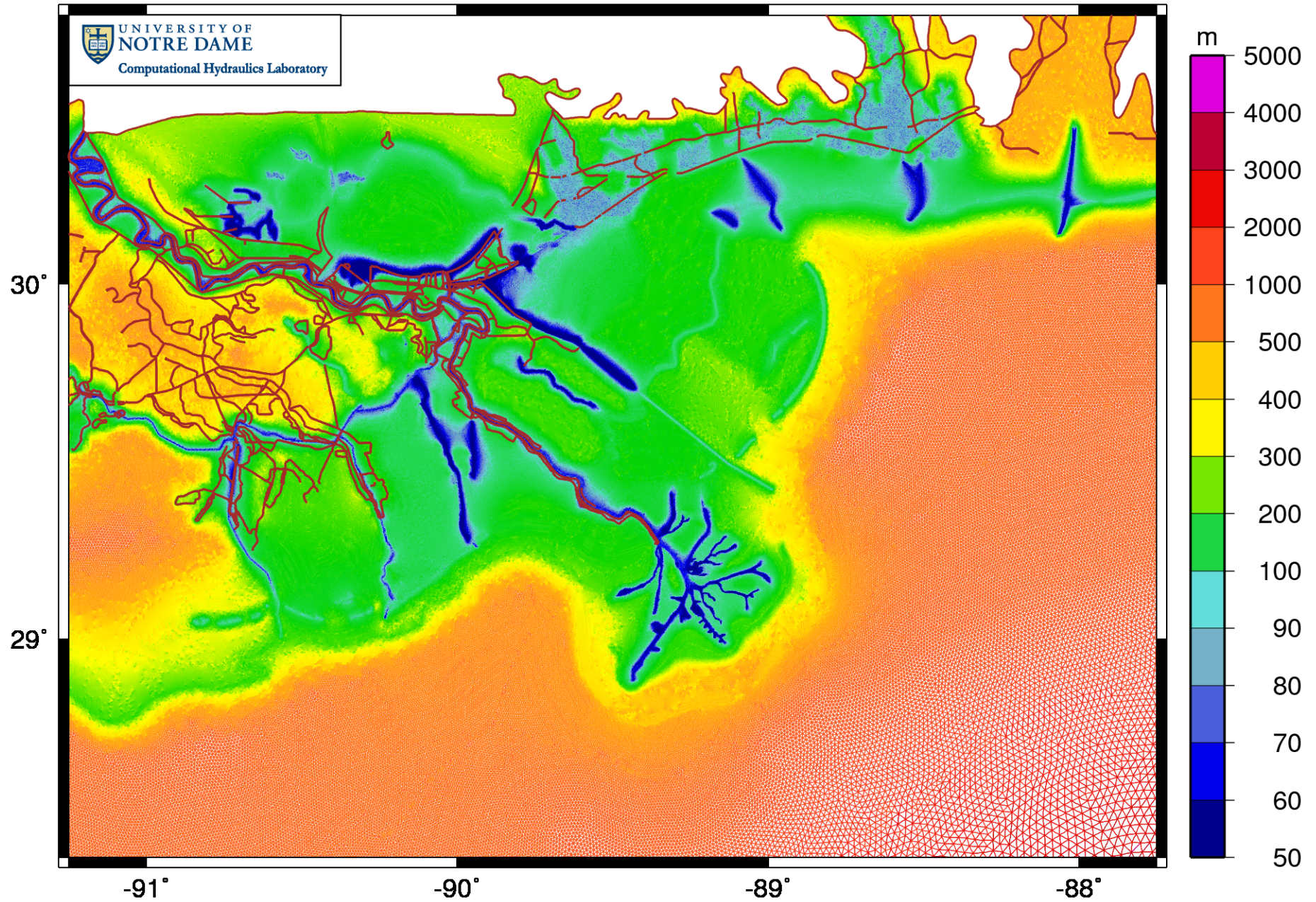
Southeastern Louisiana



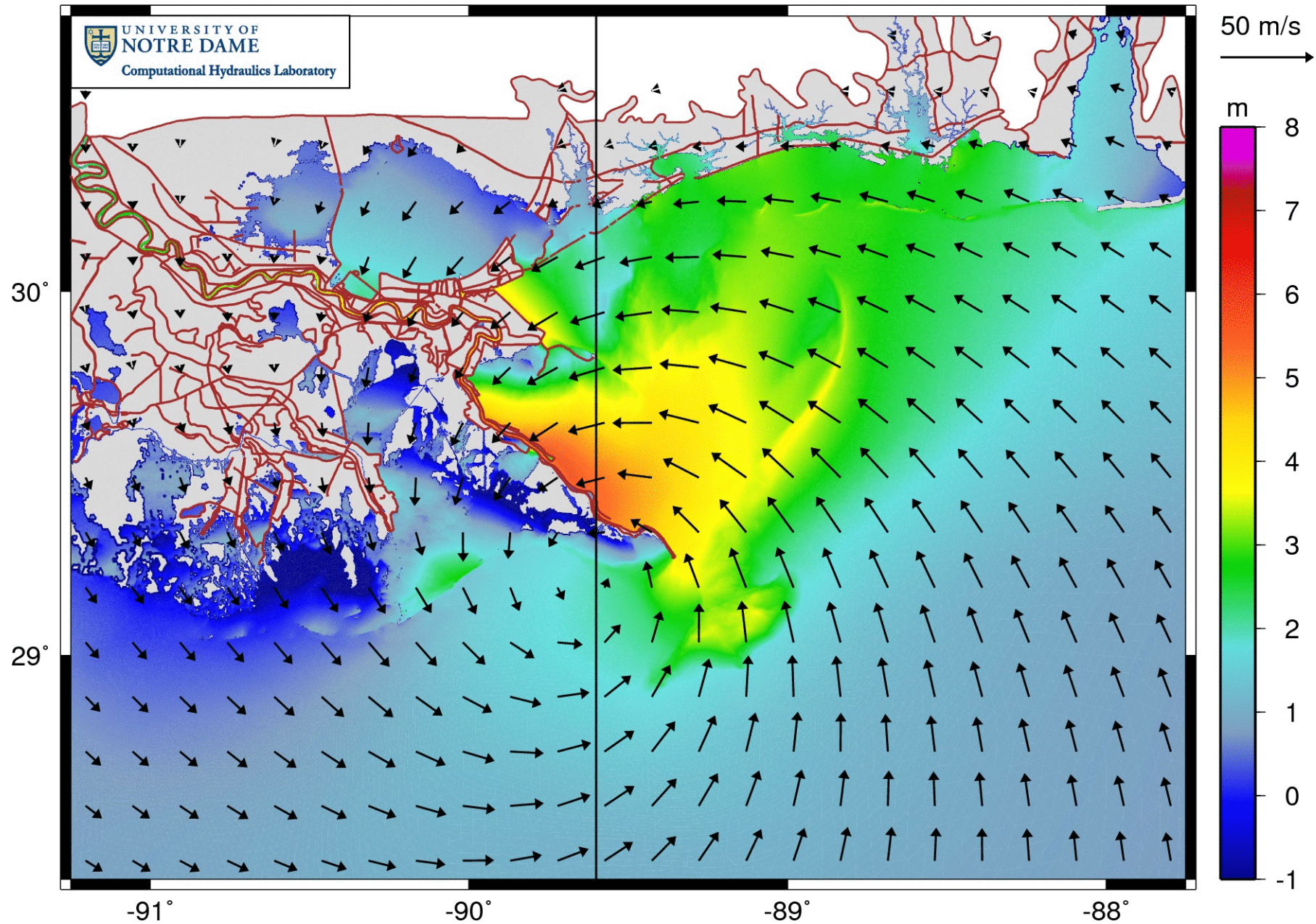
Model : Bathymetry and Topography



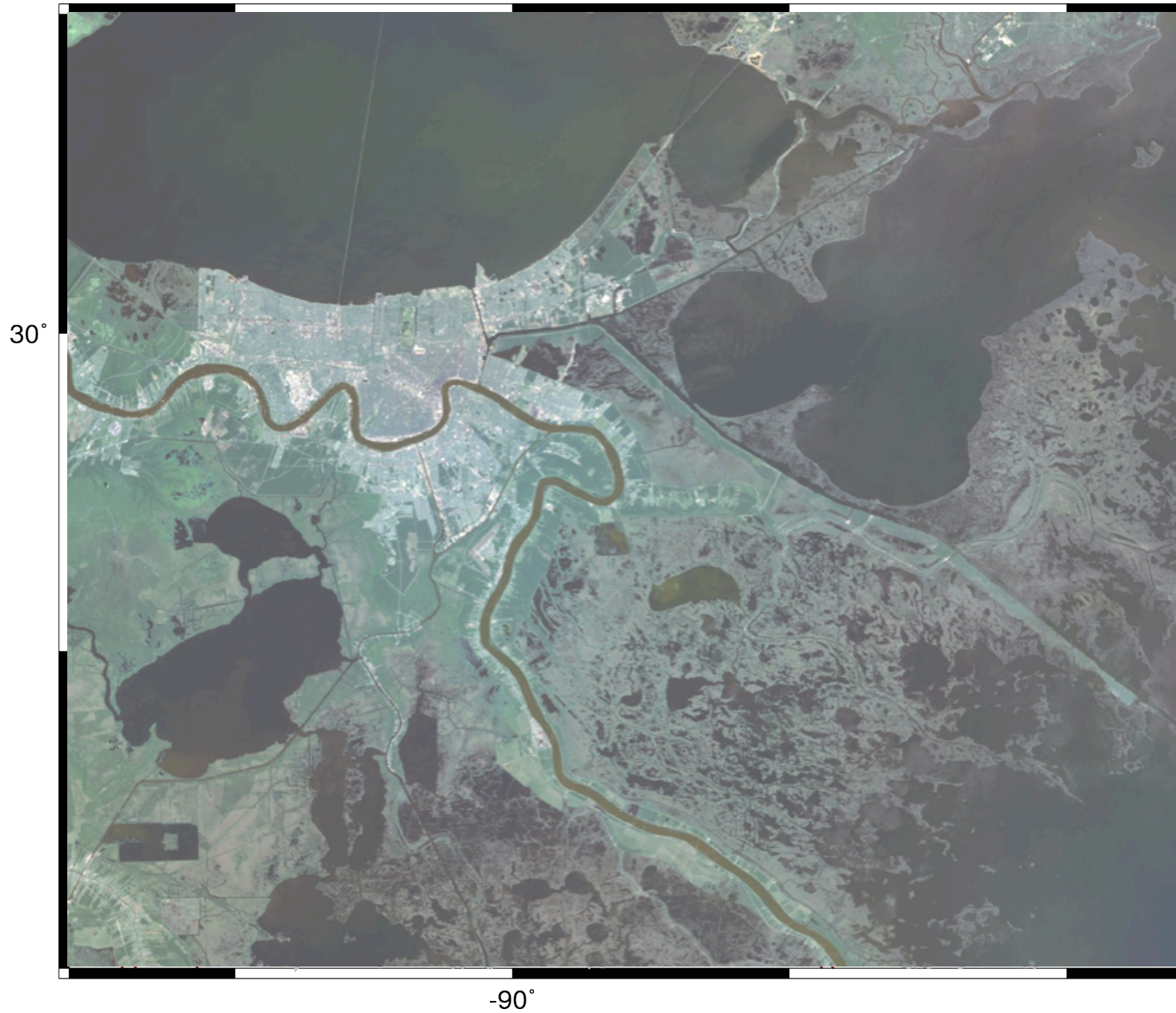
Model : Mesh Sizes



Katrina : Water Levels : Day of Landfall



Applications : Surge Barrier Design : USACE



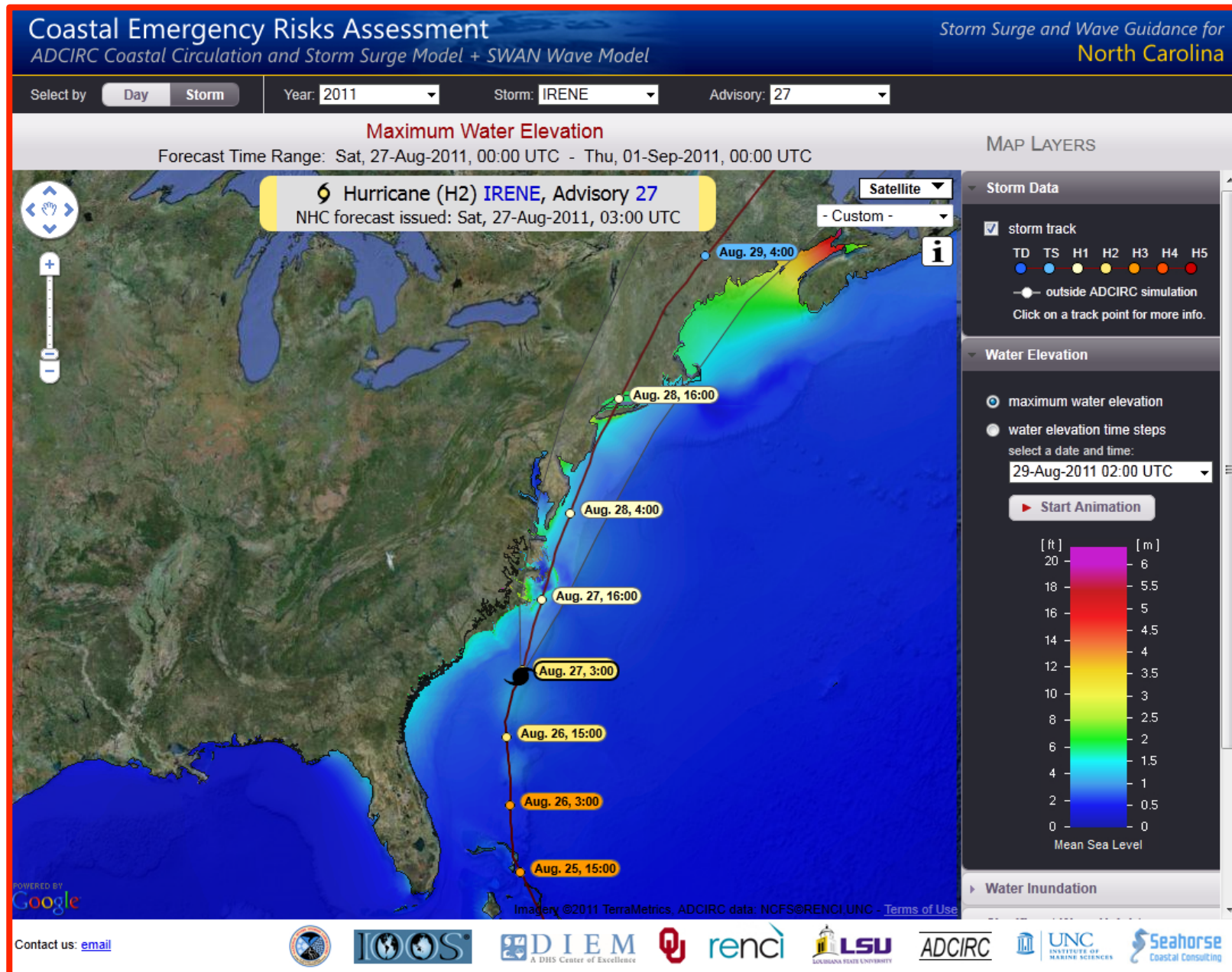
Applications : Surge Barrier Design : USACE



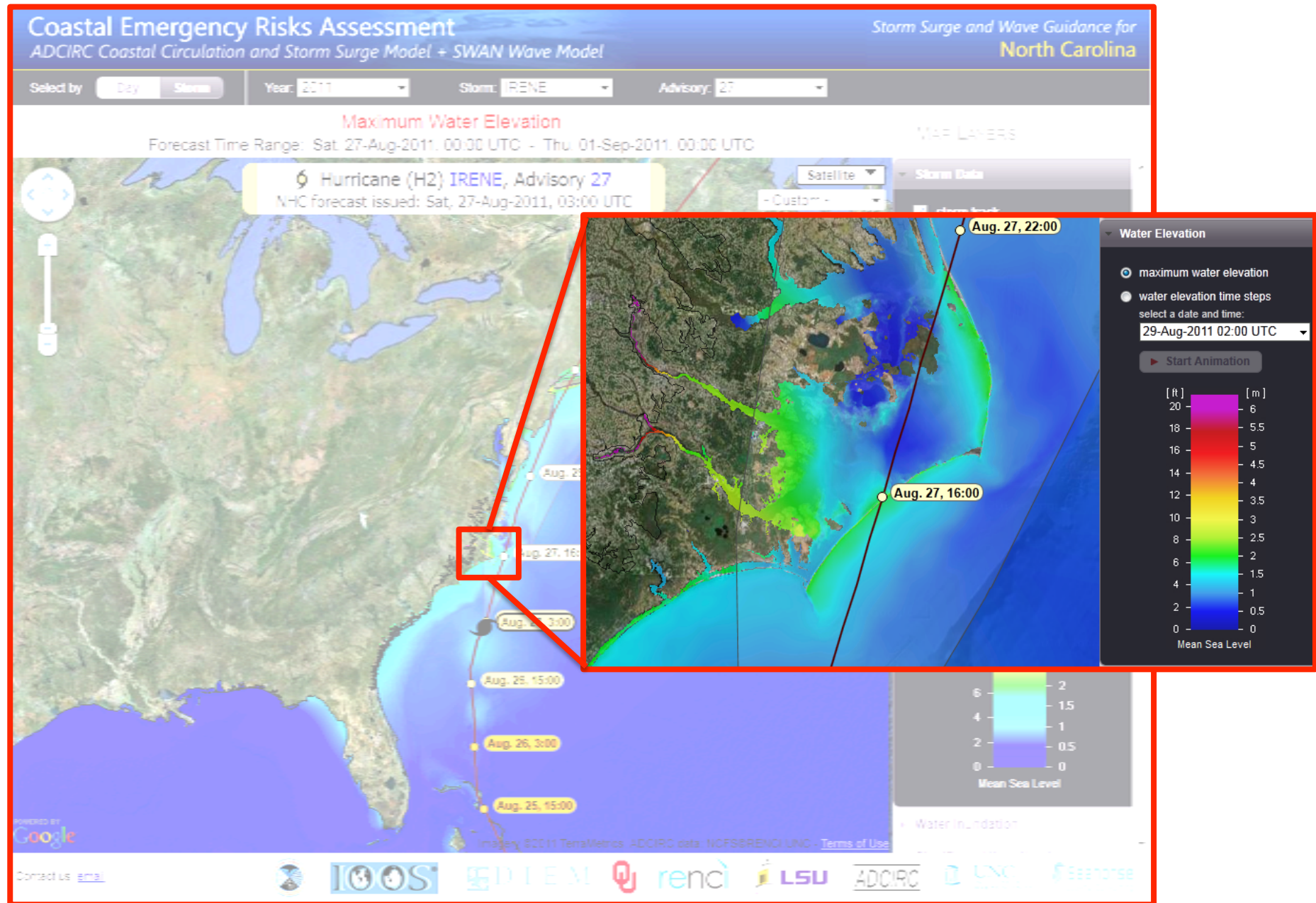
Applications : Surge Barrier Design : USACE



Applications : Hurricane Forecasting



Applications : Hurricane Forecasting



Applications : Nearshore Oil Transport : NSF / DHS

Deepwater Horizon was a 9-year-old,
mobile offshore drilling unit

Located 66km from the Louisiana coastline,
in 1500m of water

Platform was engulfed on 20 April by an
explosion of methane gas; structure
burned for more than 24hr before
sinking on 22 April

Explosion killed 11 workers and injured 17

Oil spill flow rates:

- Estimated to have begun at a rate
of $9900 \text{ m}^3 \text{ d}^{-1}$
- Diminished over time to a final rate
of $8400 \text{ m}^3 \text{ d}^{-1}$ on 15 July 2010

Emergency responders relied on satellite
and aerial imagery



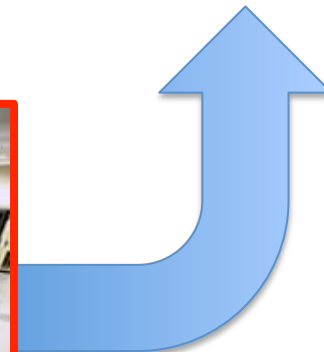
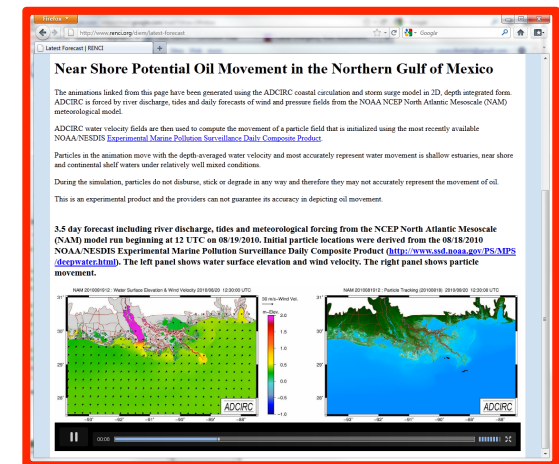
Nearshore Oil Transport : Motivation

Satellite imagery can only show current location of the slick

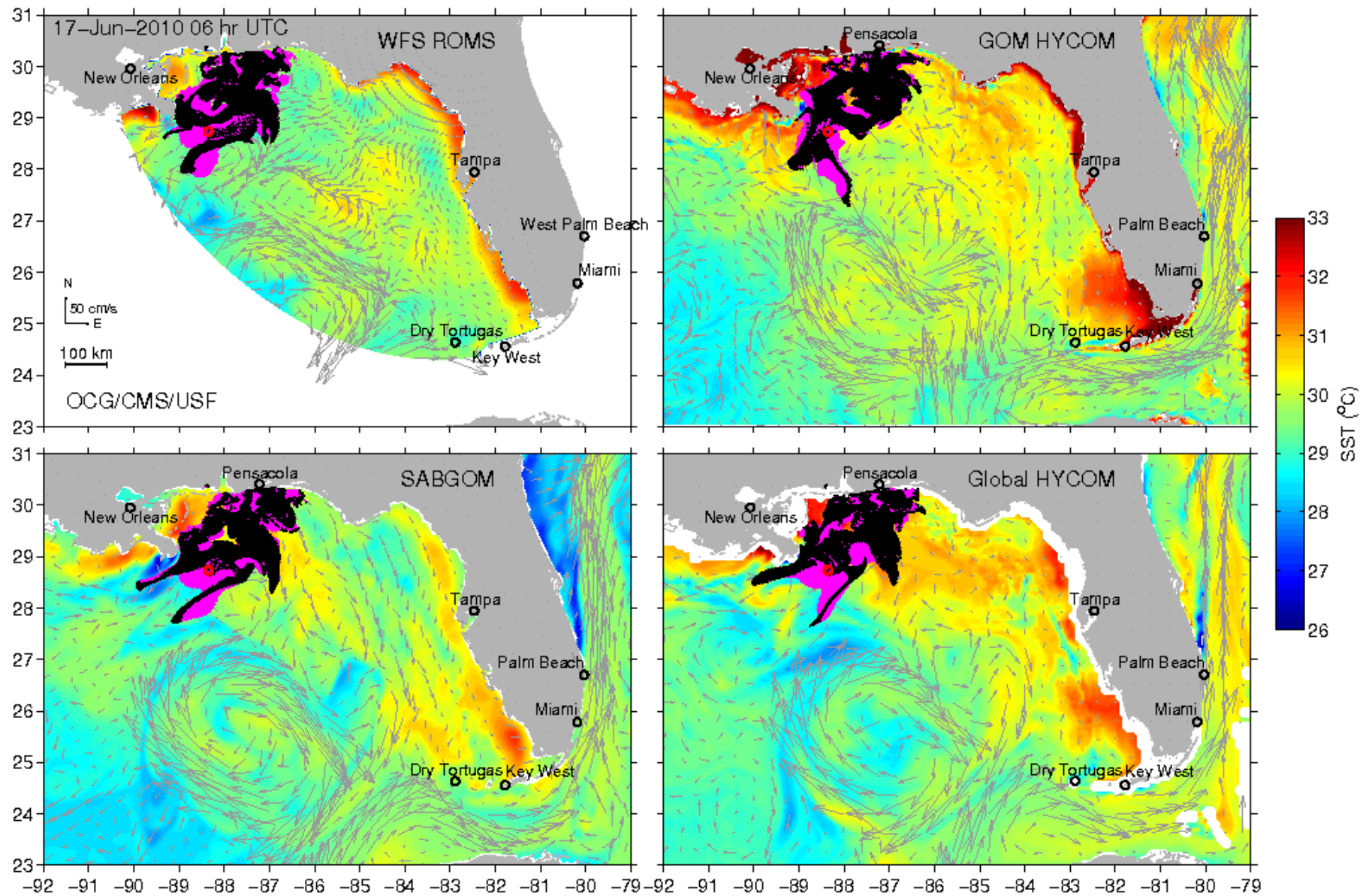
- Where will the oil move?
- What happens if a hurricane approaches?

Forecasts need to be accurate and fast

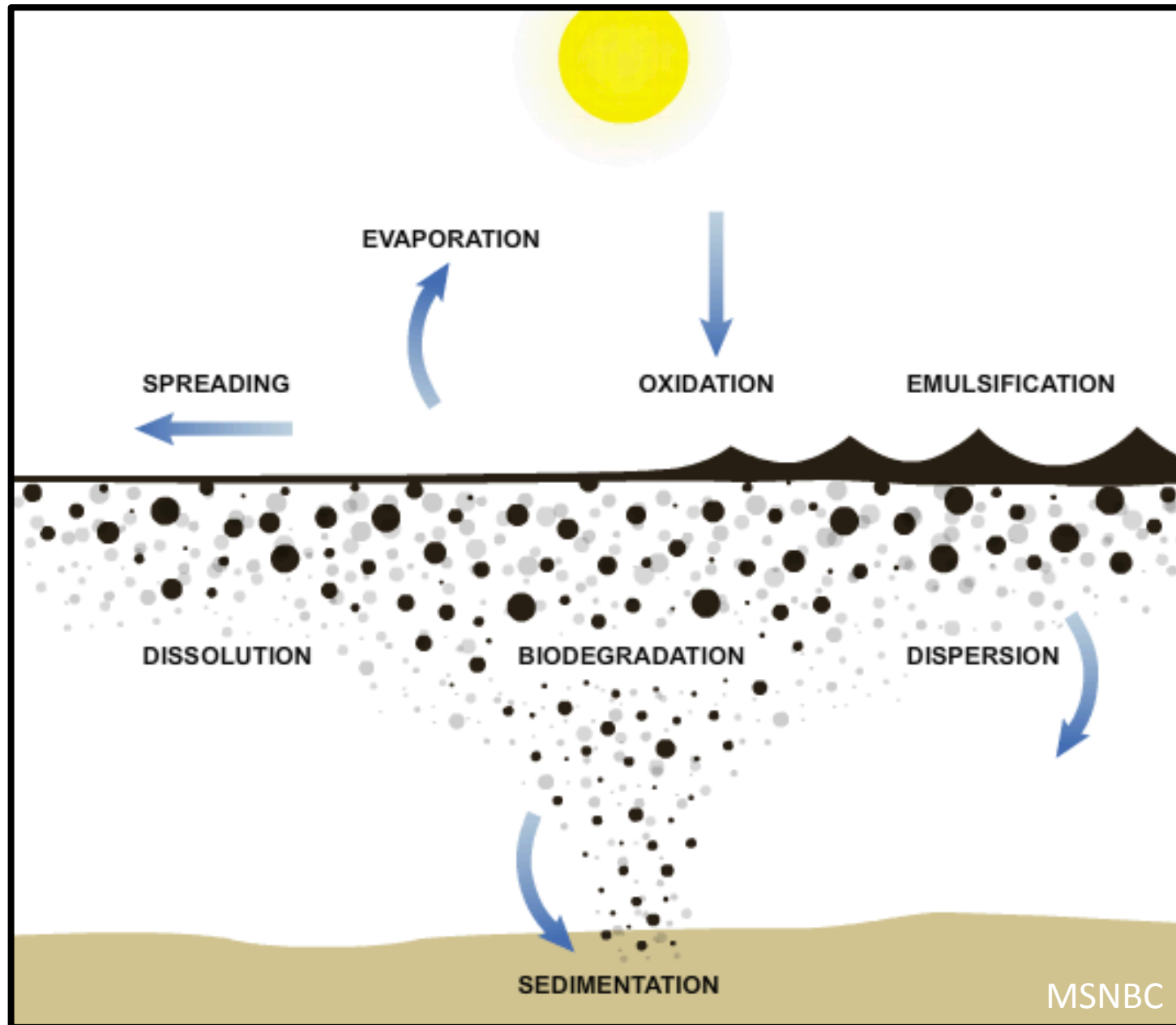
- Share computed circulation with NOAA, other spill modelers
- Share oil transport with emergency managers in real time (<http://adcirc.org/oilspill>)



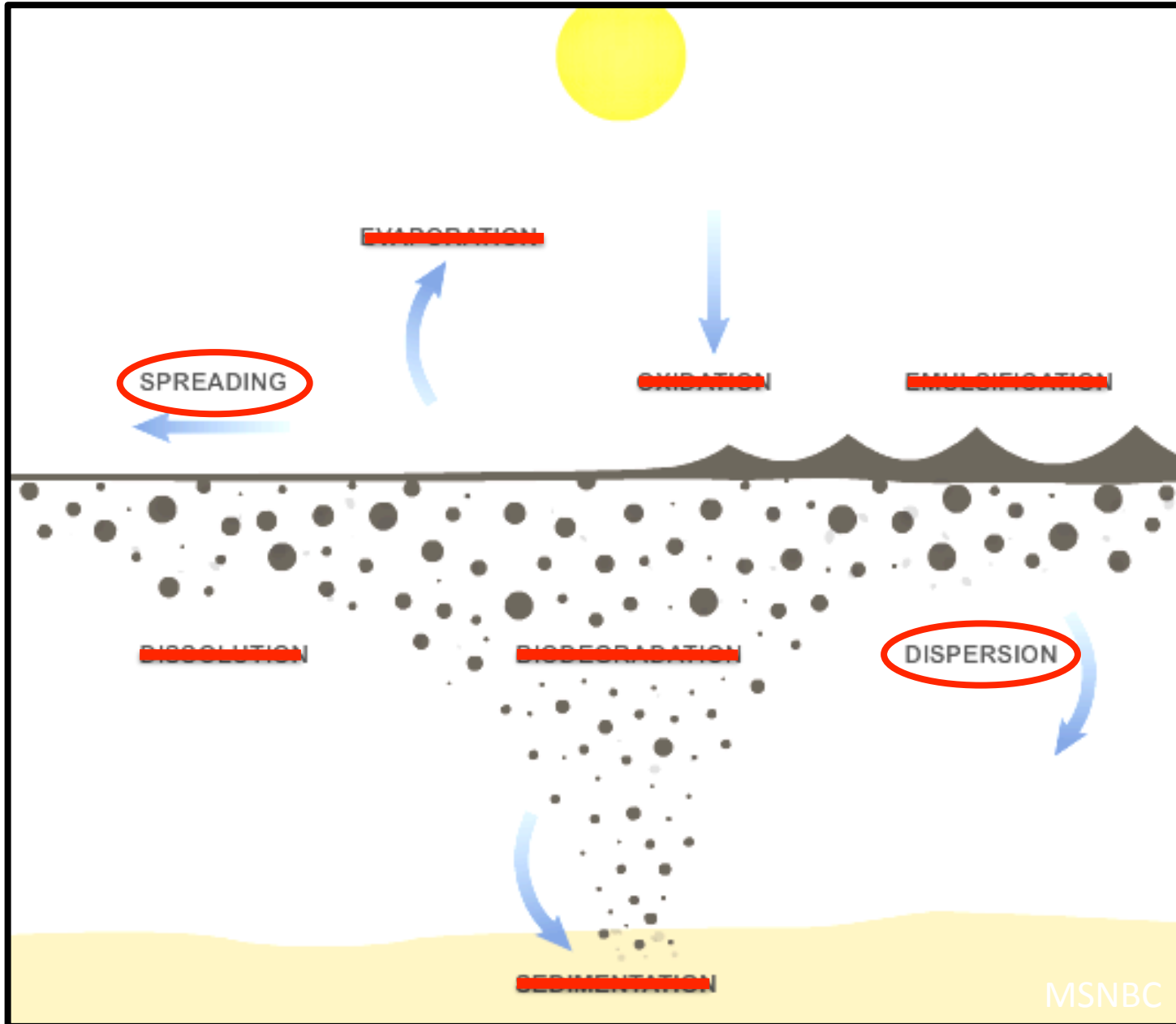
Nearshore Oil Transport : Motivation



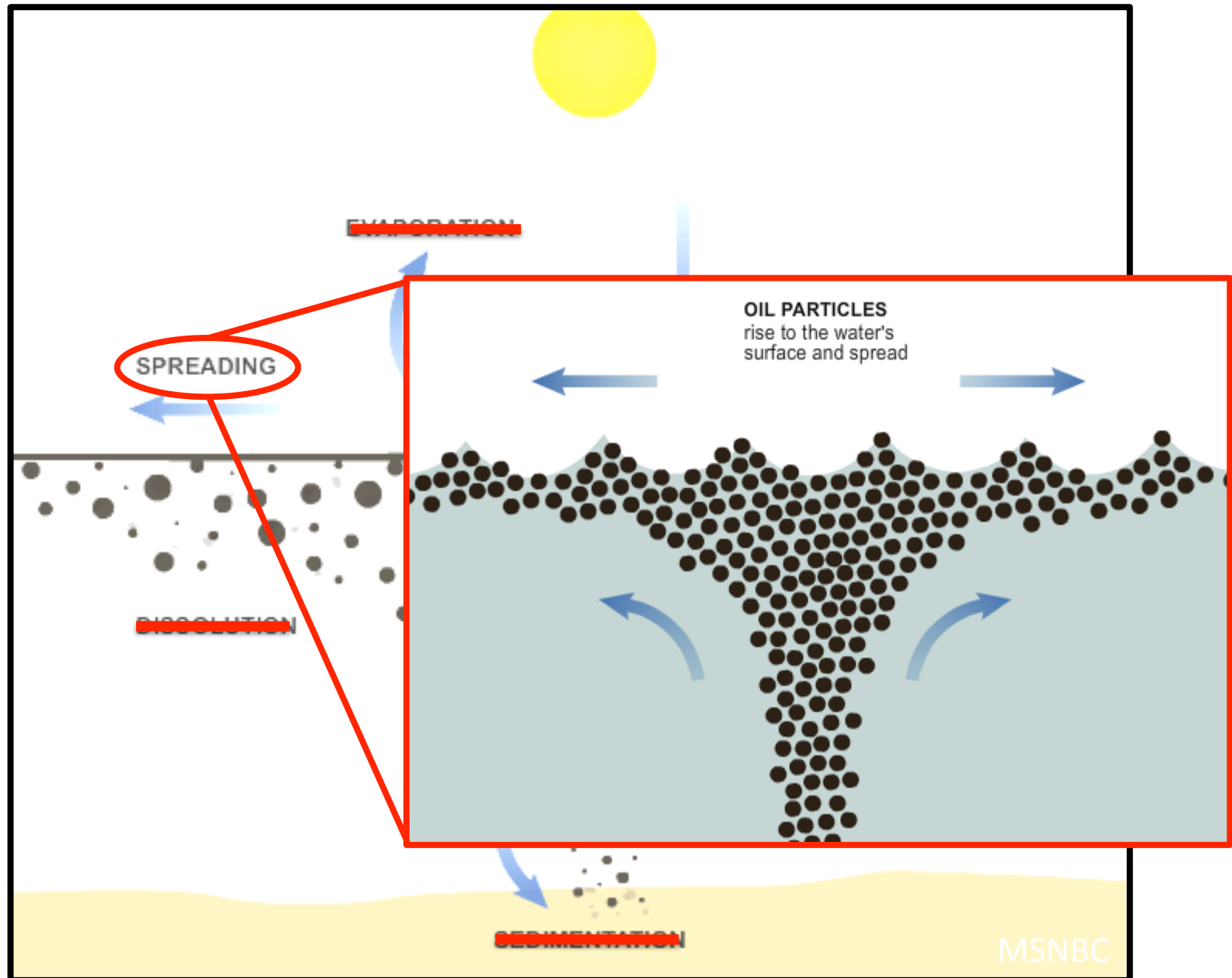
Nearshore Oil Transport : Challenges



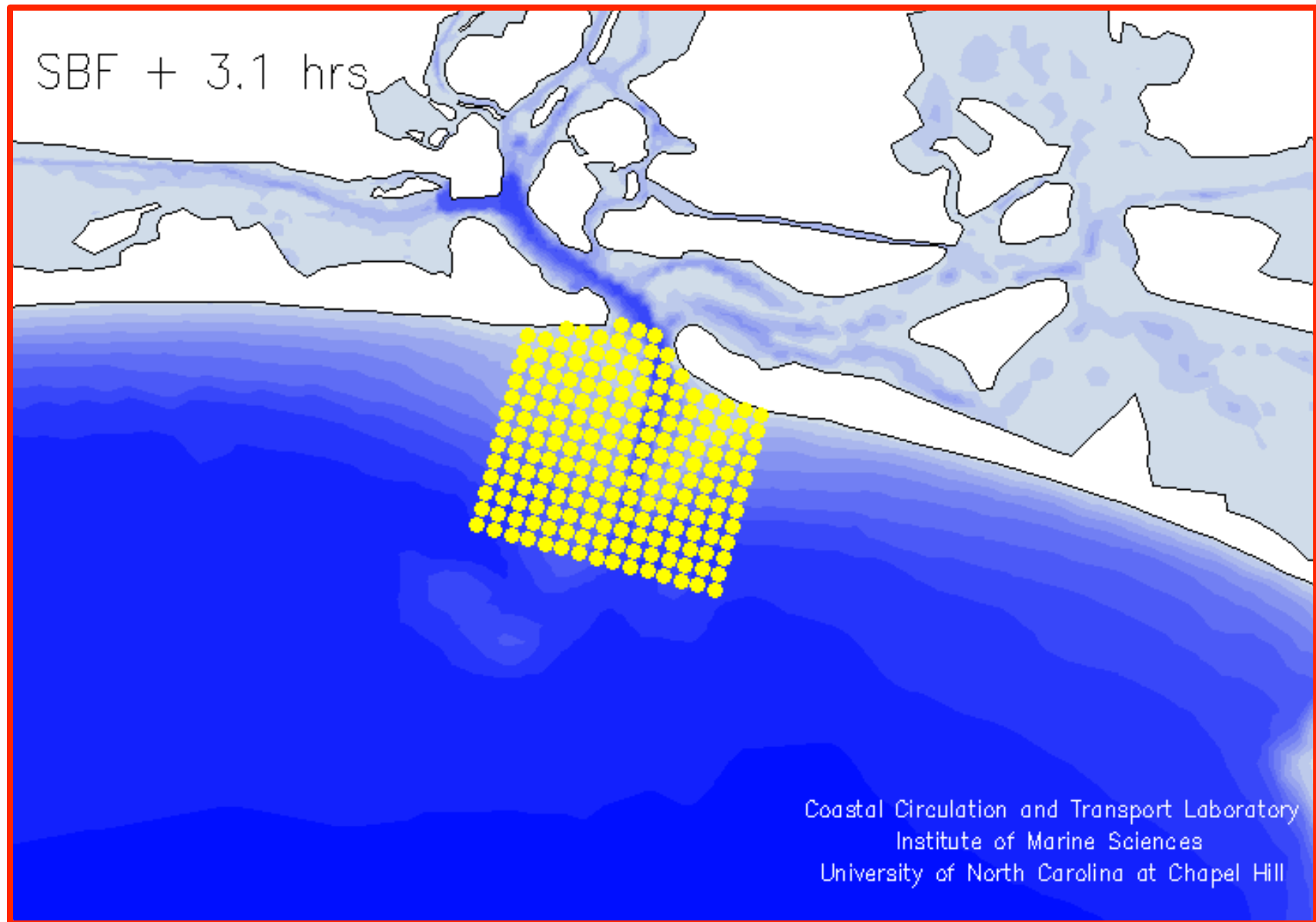
Nearshore Oil Transport : Challenges



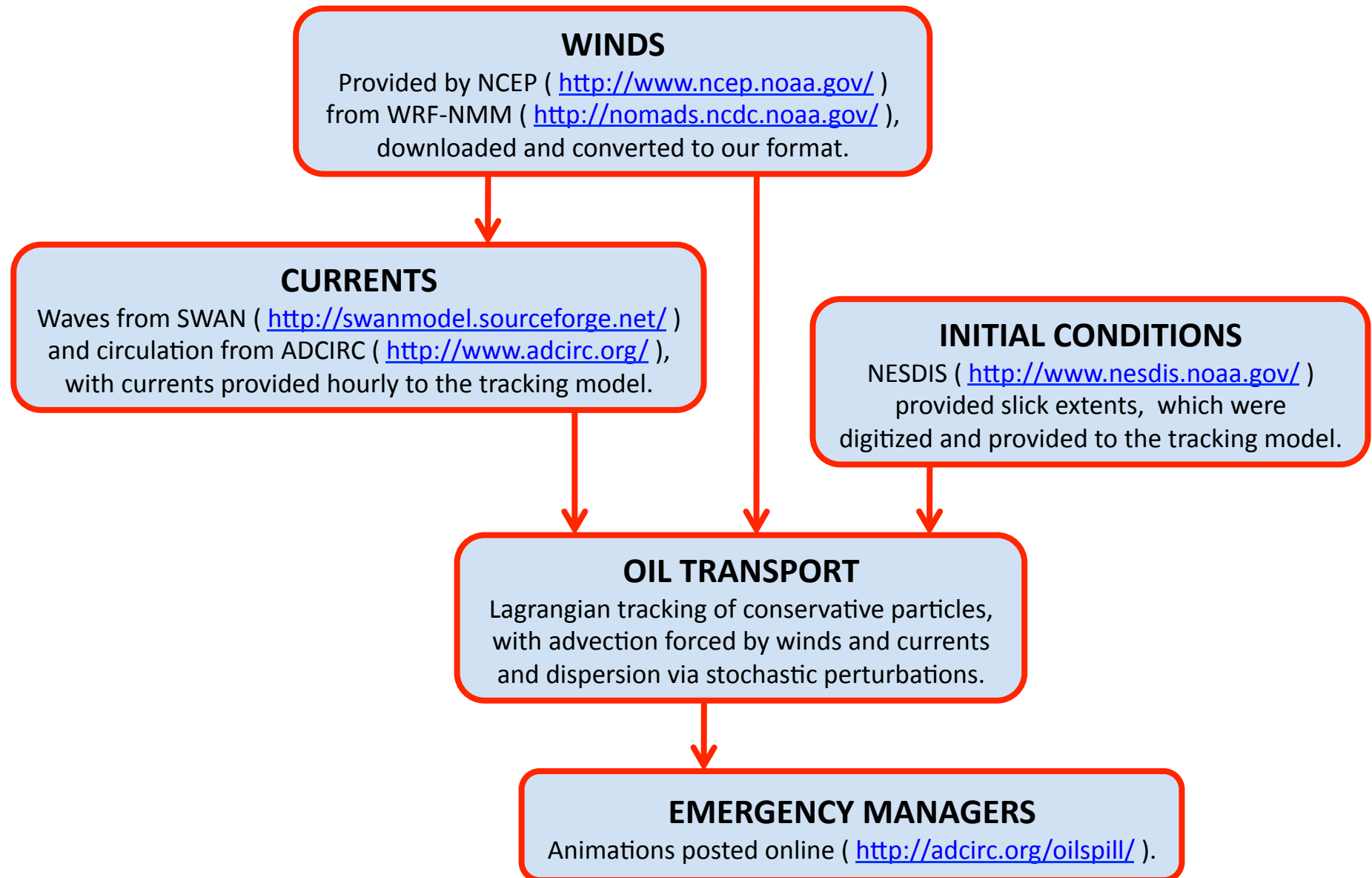
Nearshore Oil Transport : Challenges



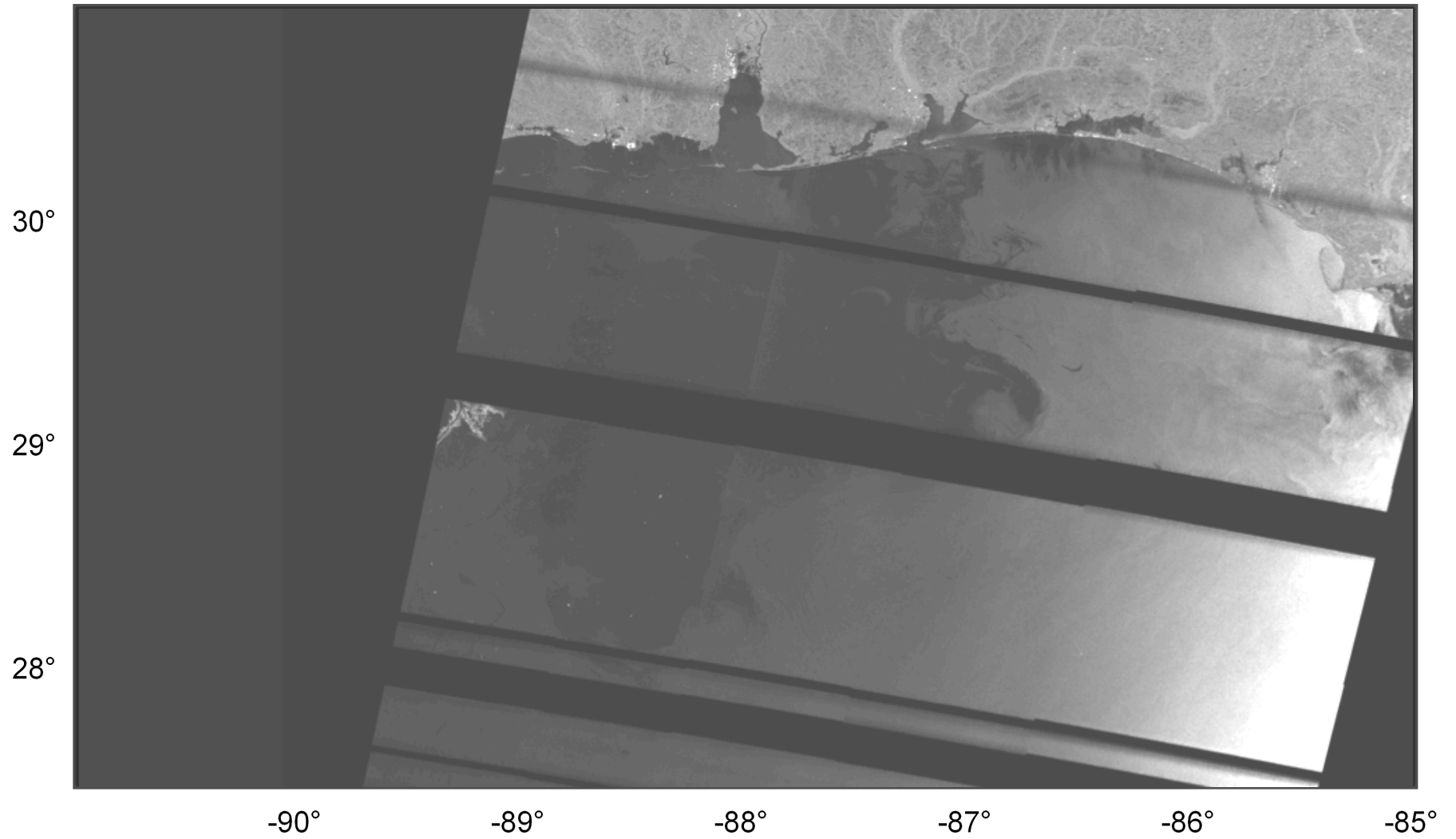
Nearshore Oil Transport : Lagrangian Particles



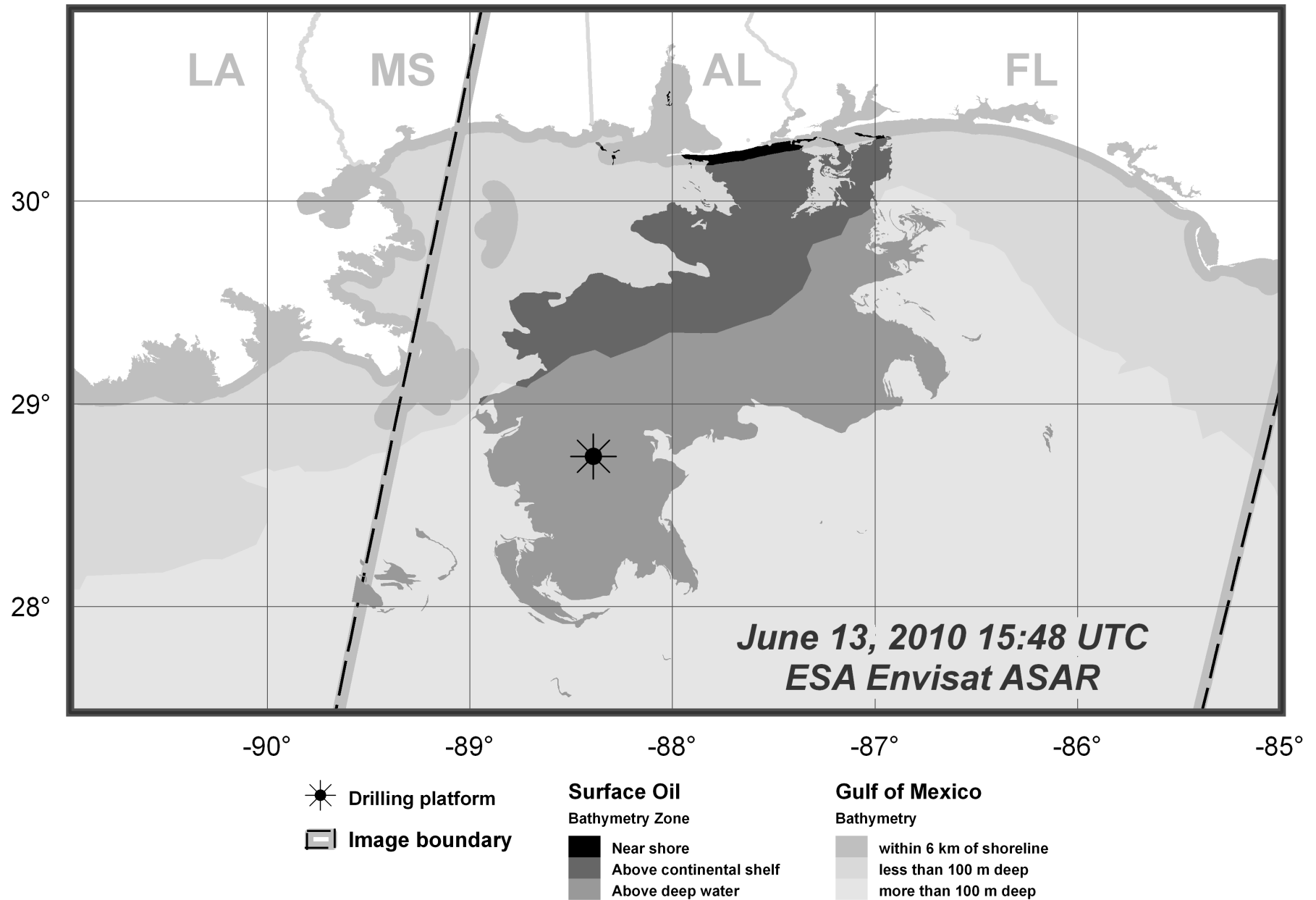
Nearshore Oil Transport : Flow Chart

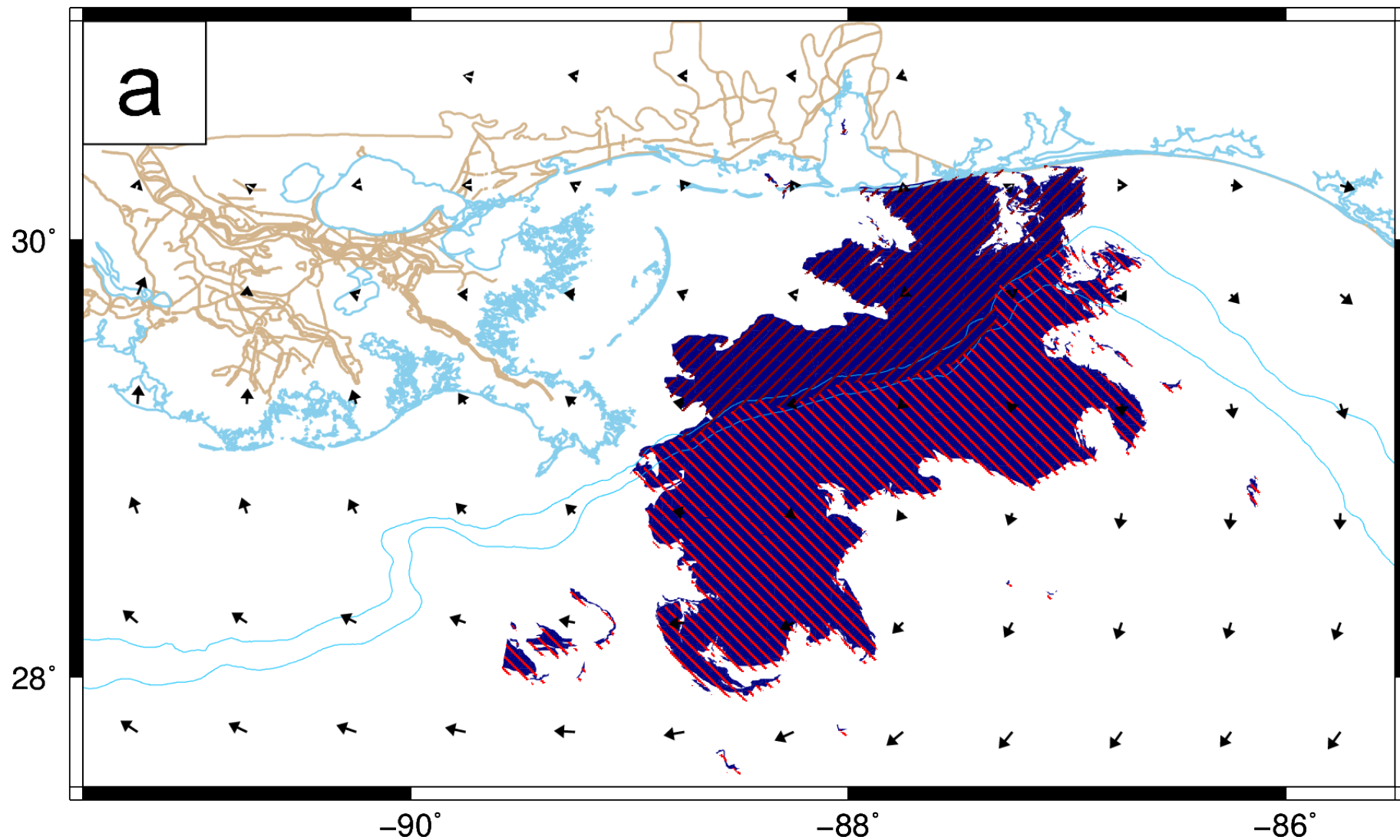
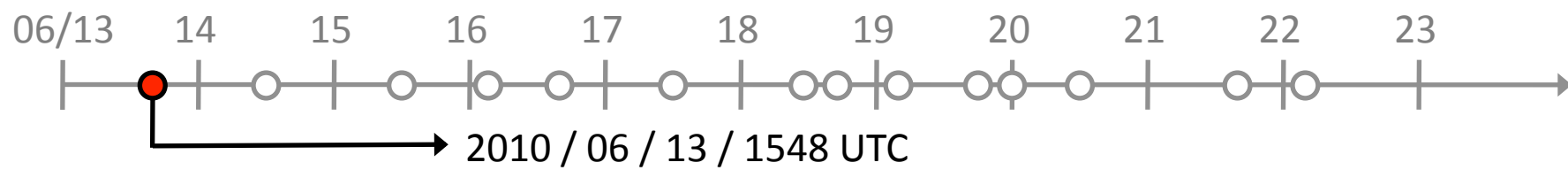


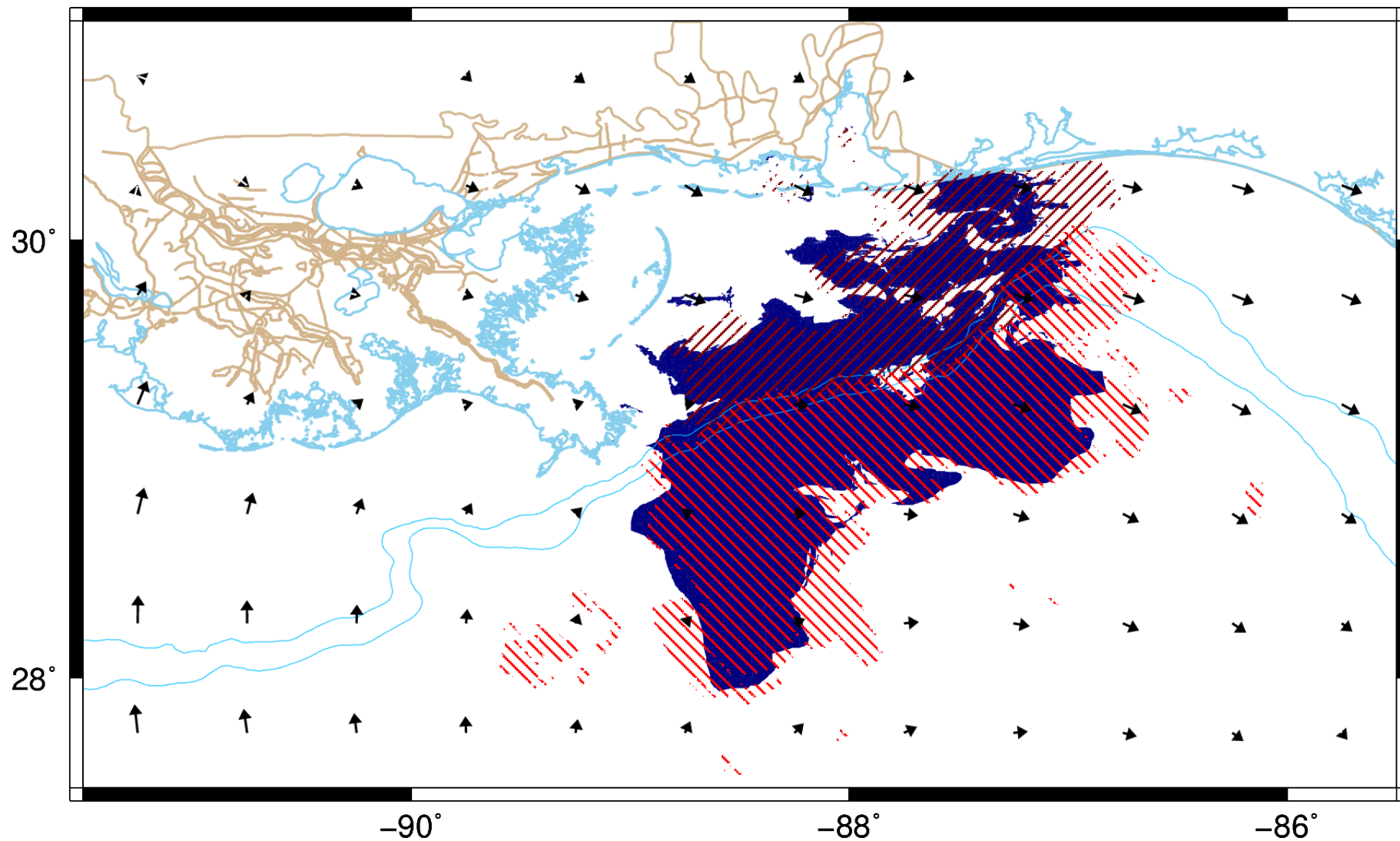
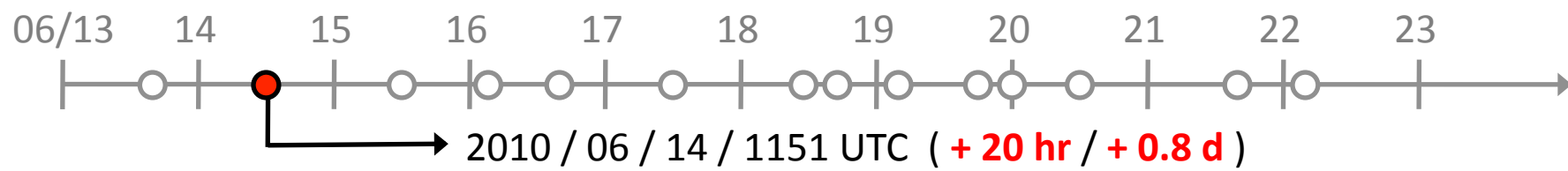
Validation : Mid-June

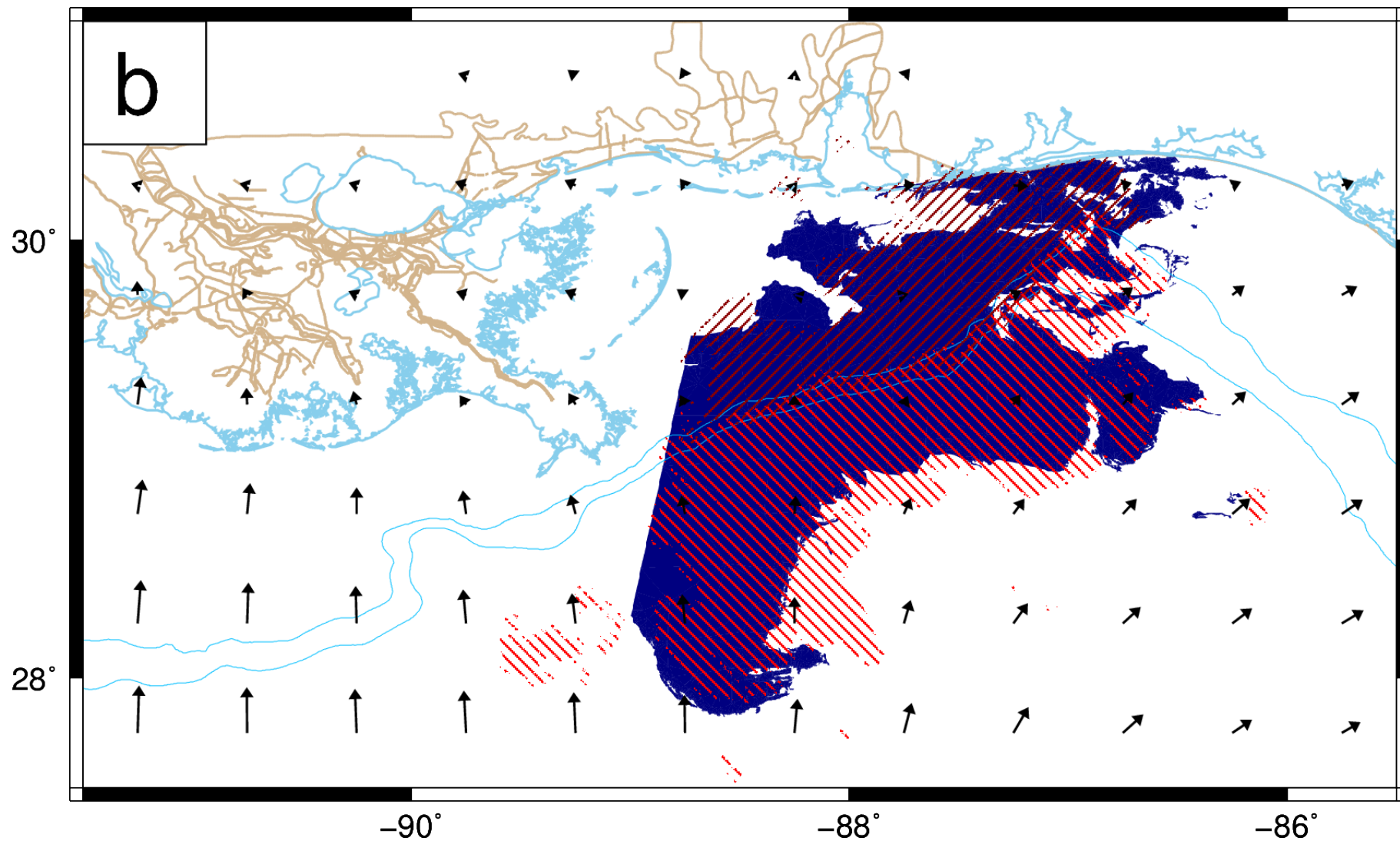
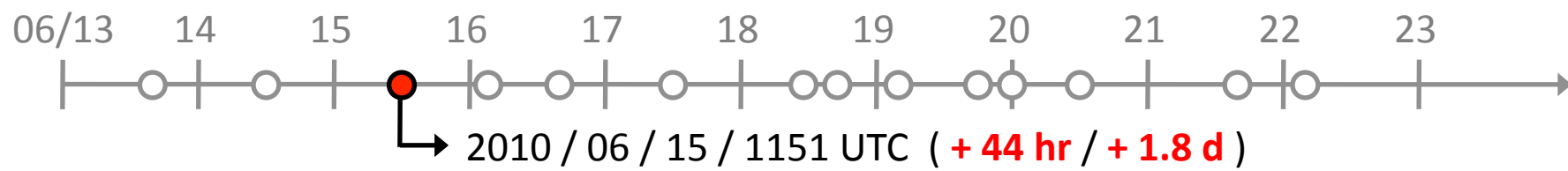


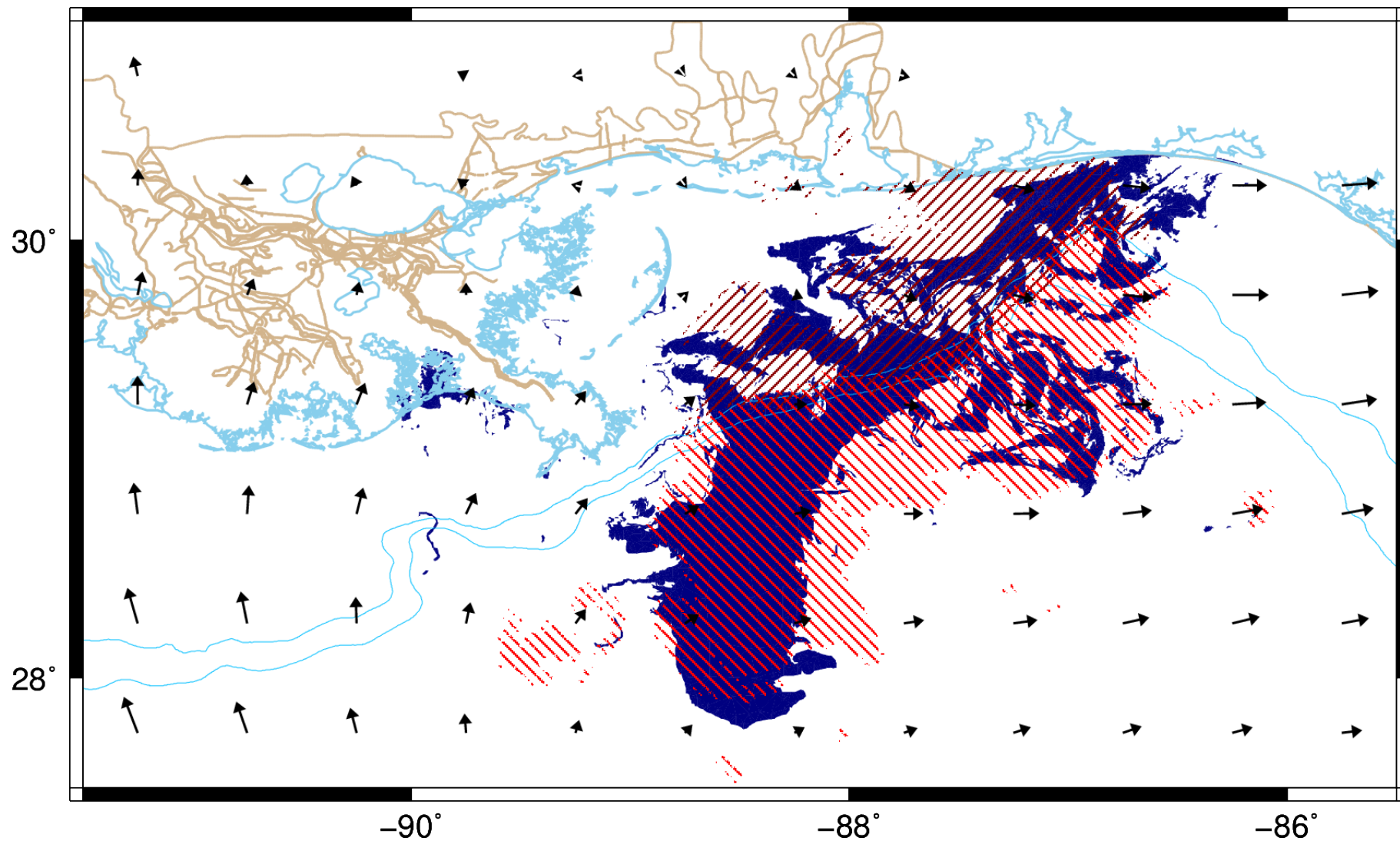
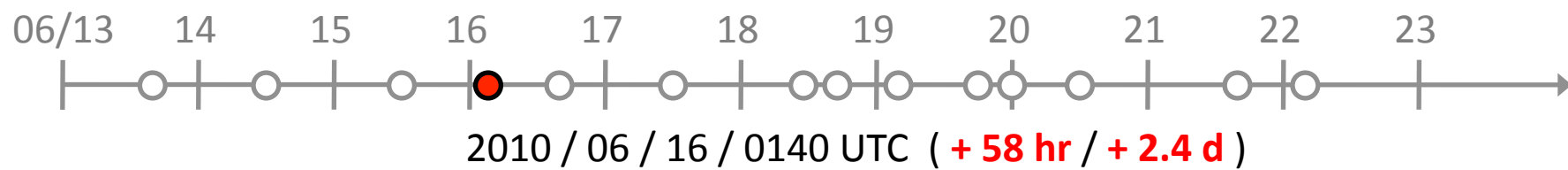
Validation : Mid-June

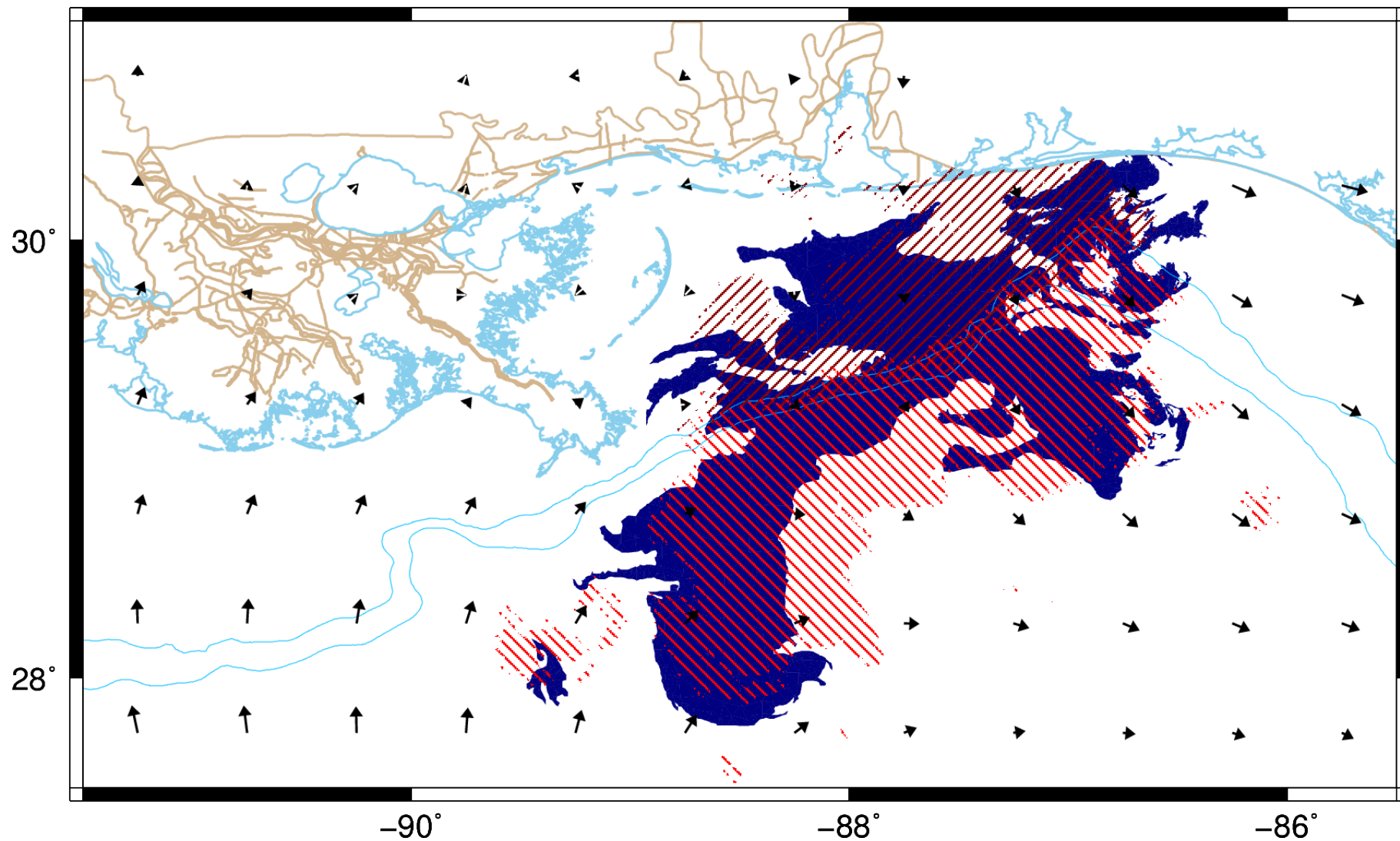
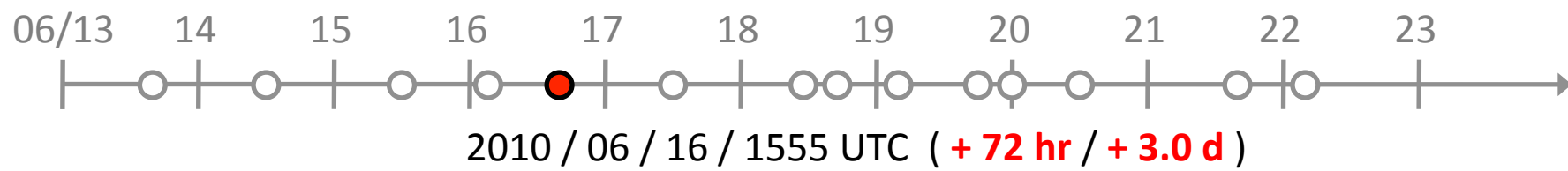


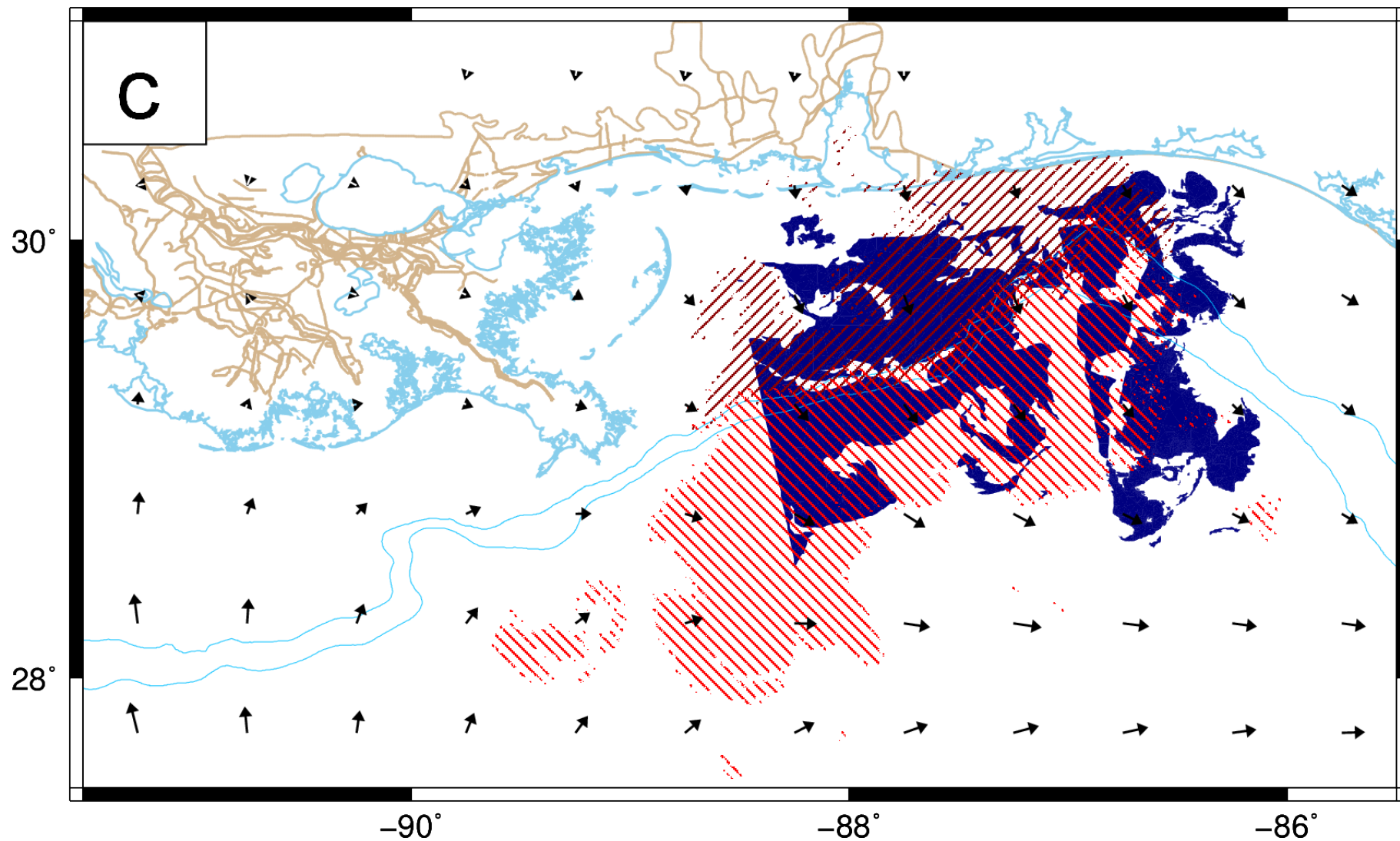
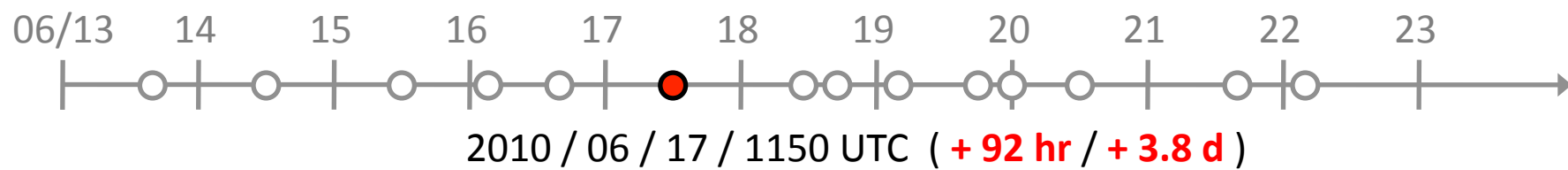






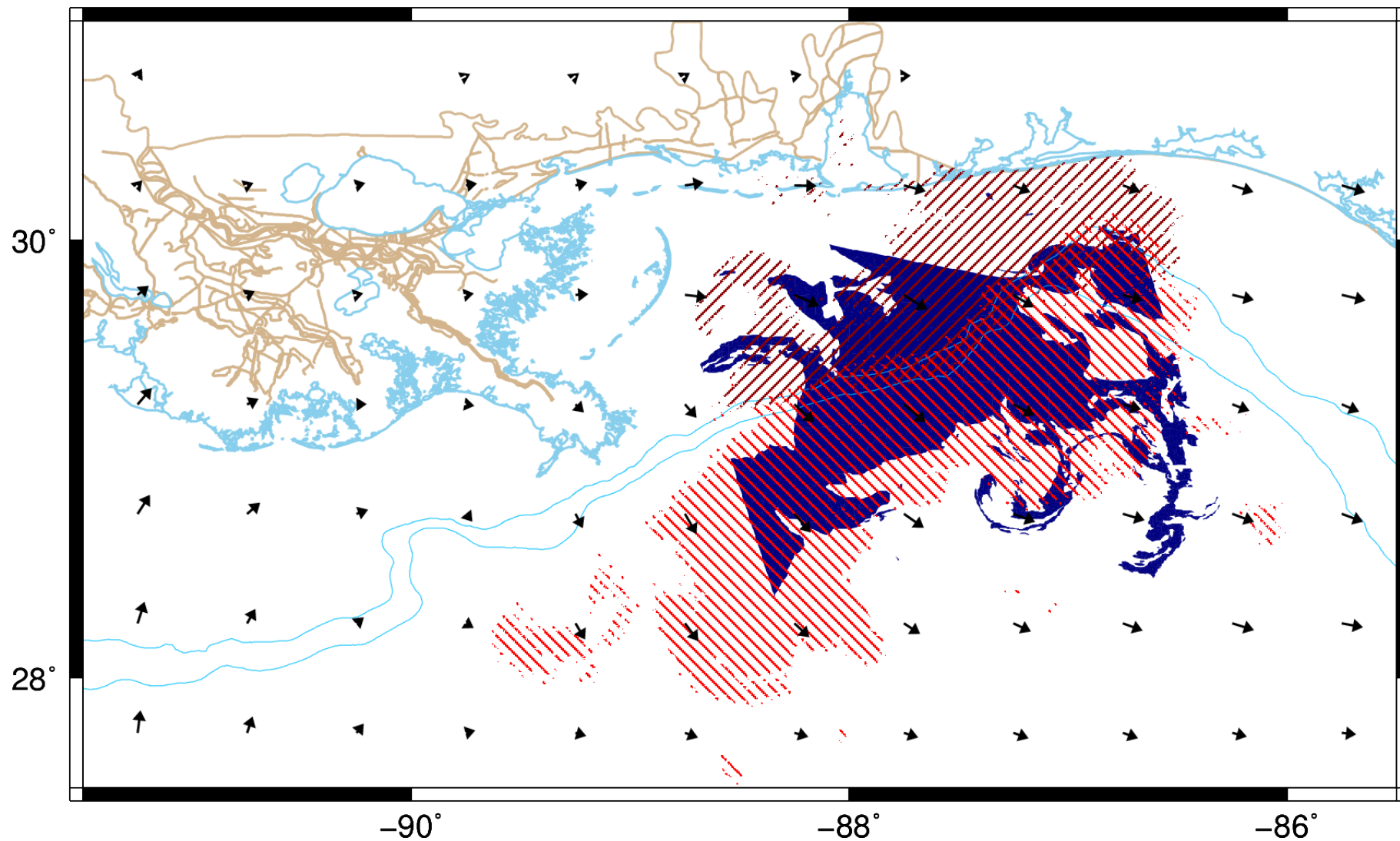


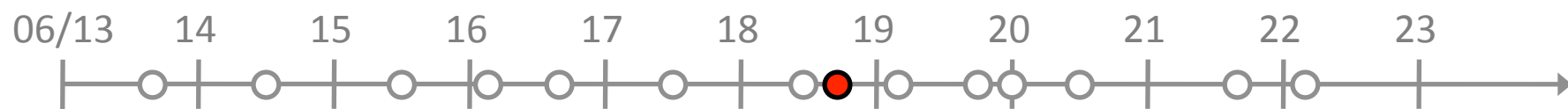




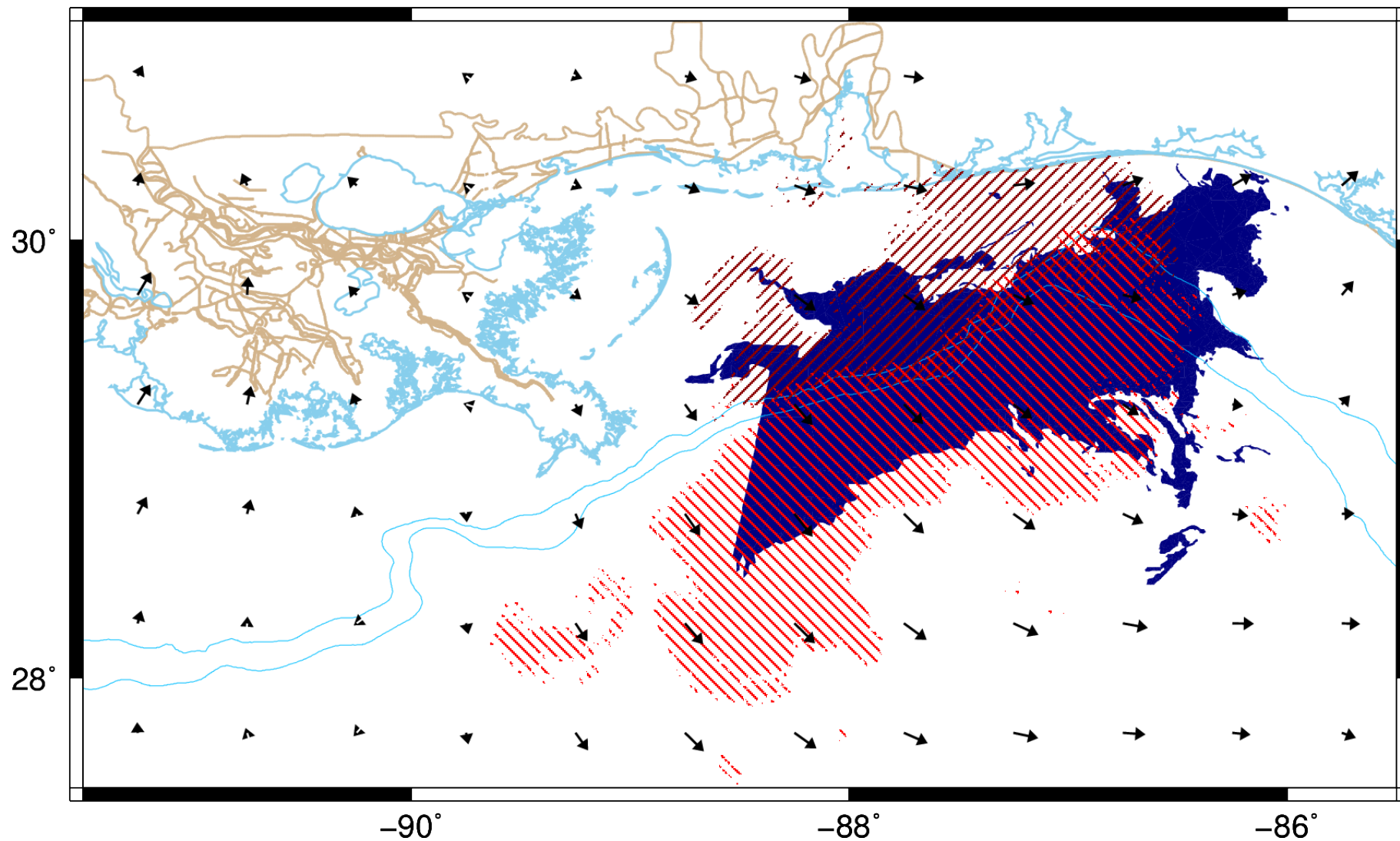


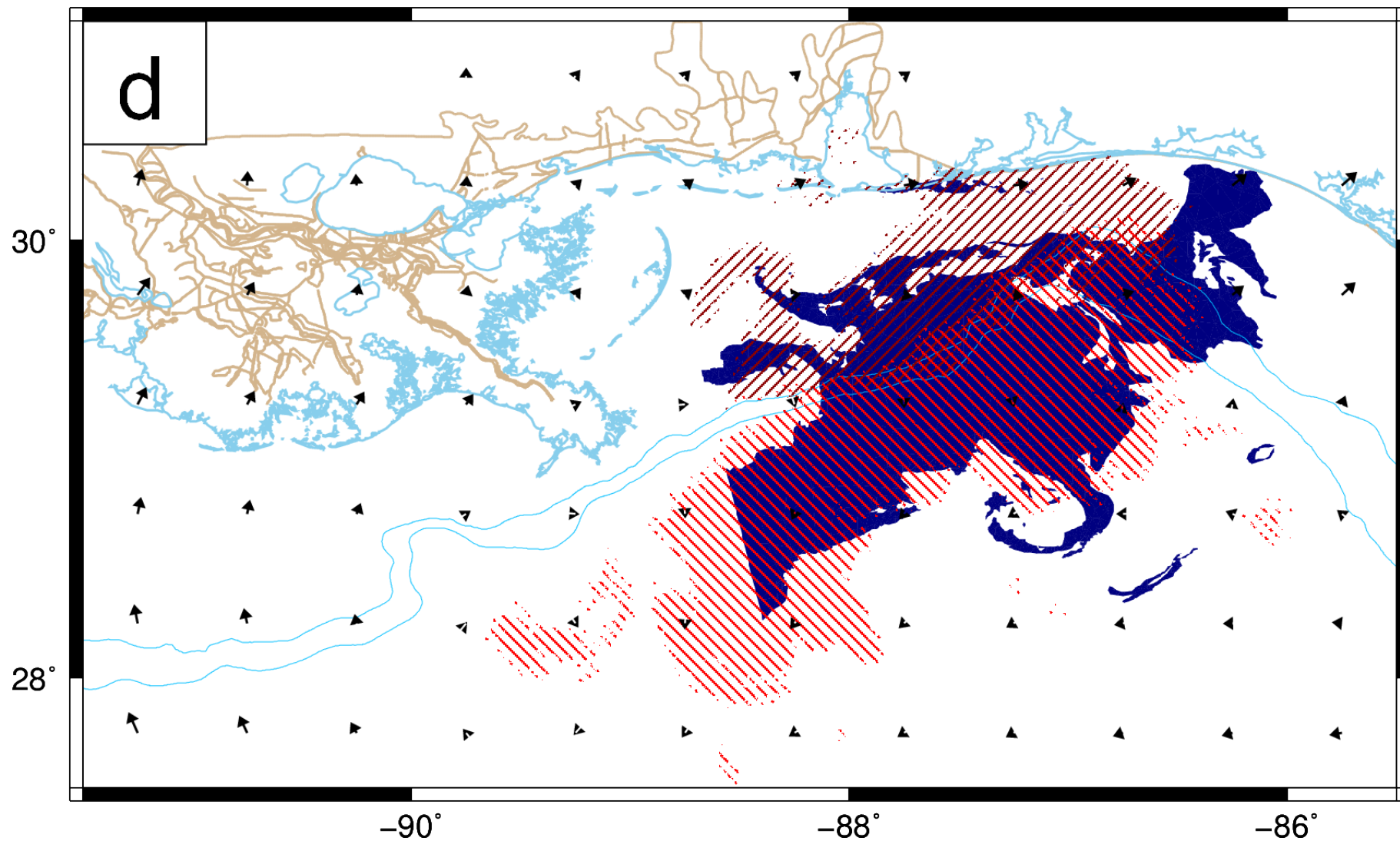
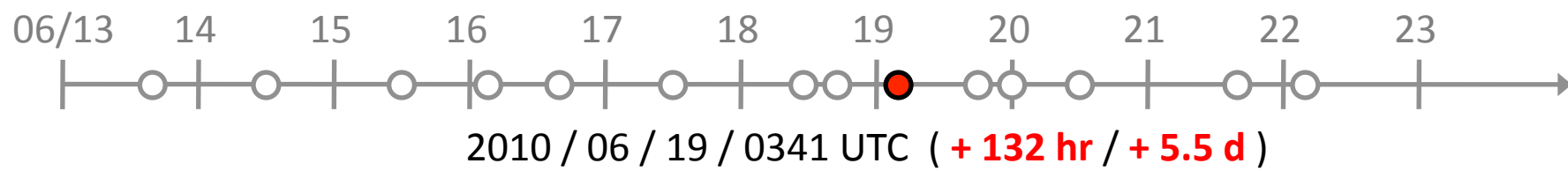
2010 / 06 / 18 / 1109 UTC (**+ 115 hr / + 4.8 d**)

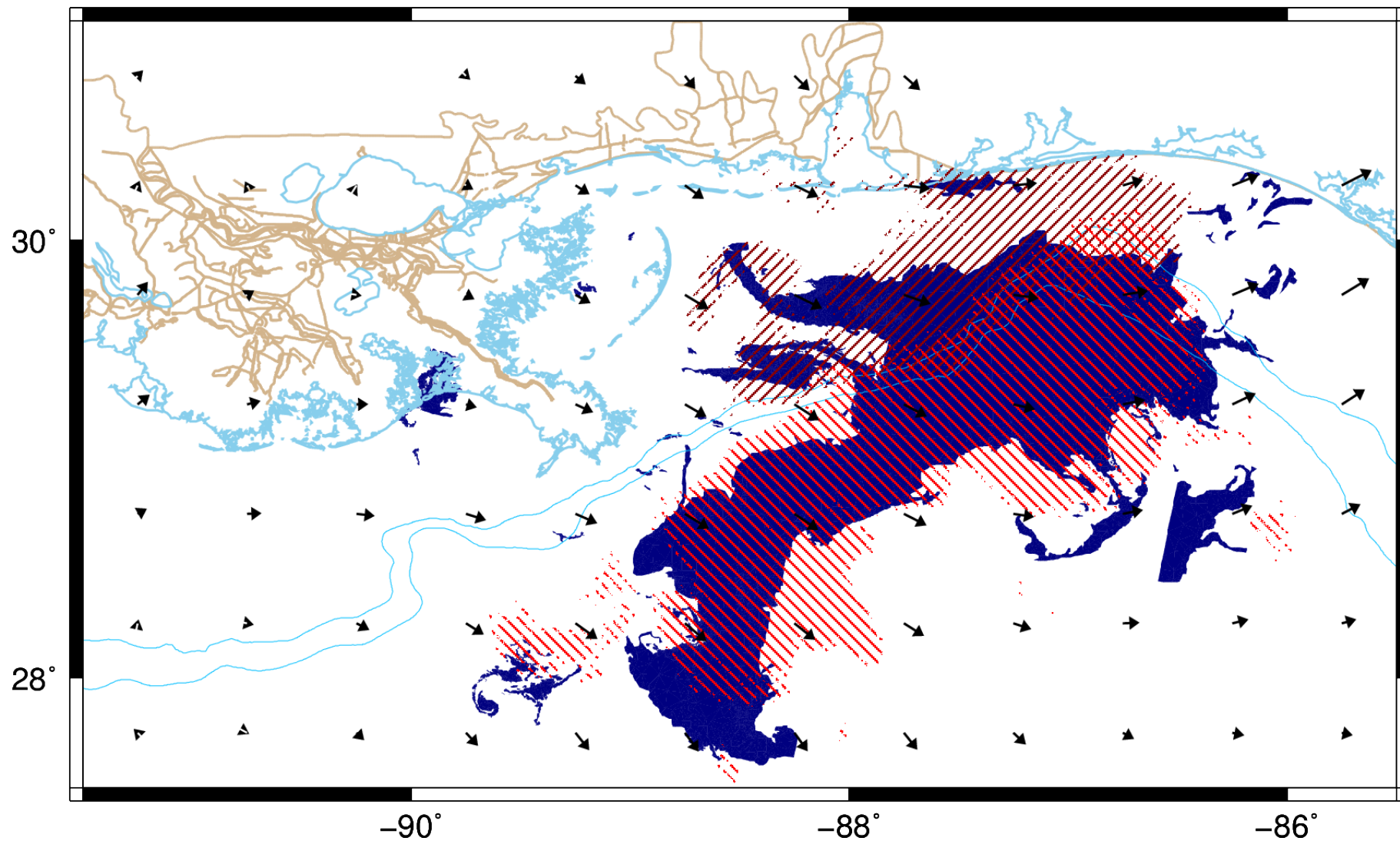
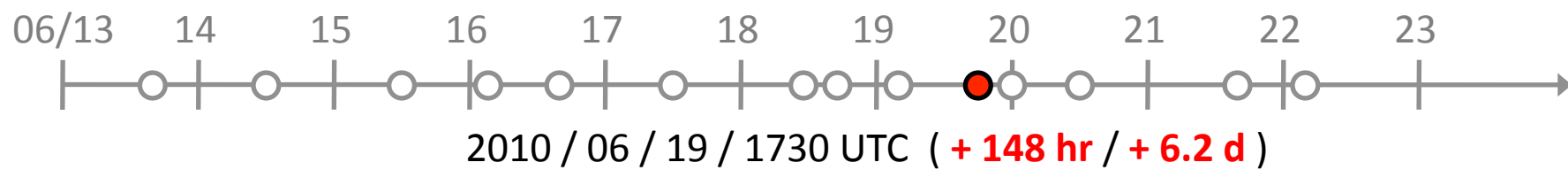


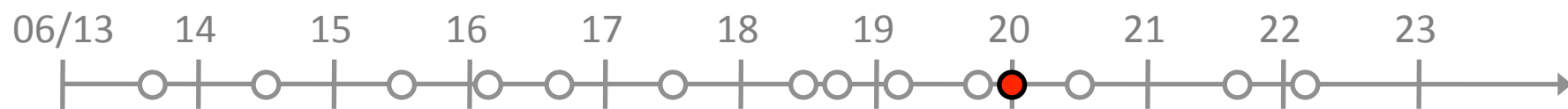


2010 / 06 / 18 / 1637 UTC (**+ 121 hr / + 5.0 d**)

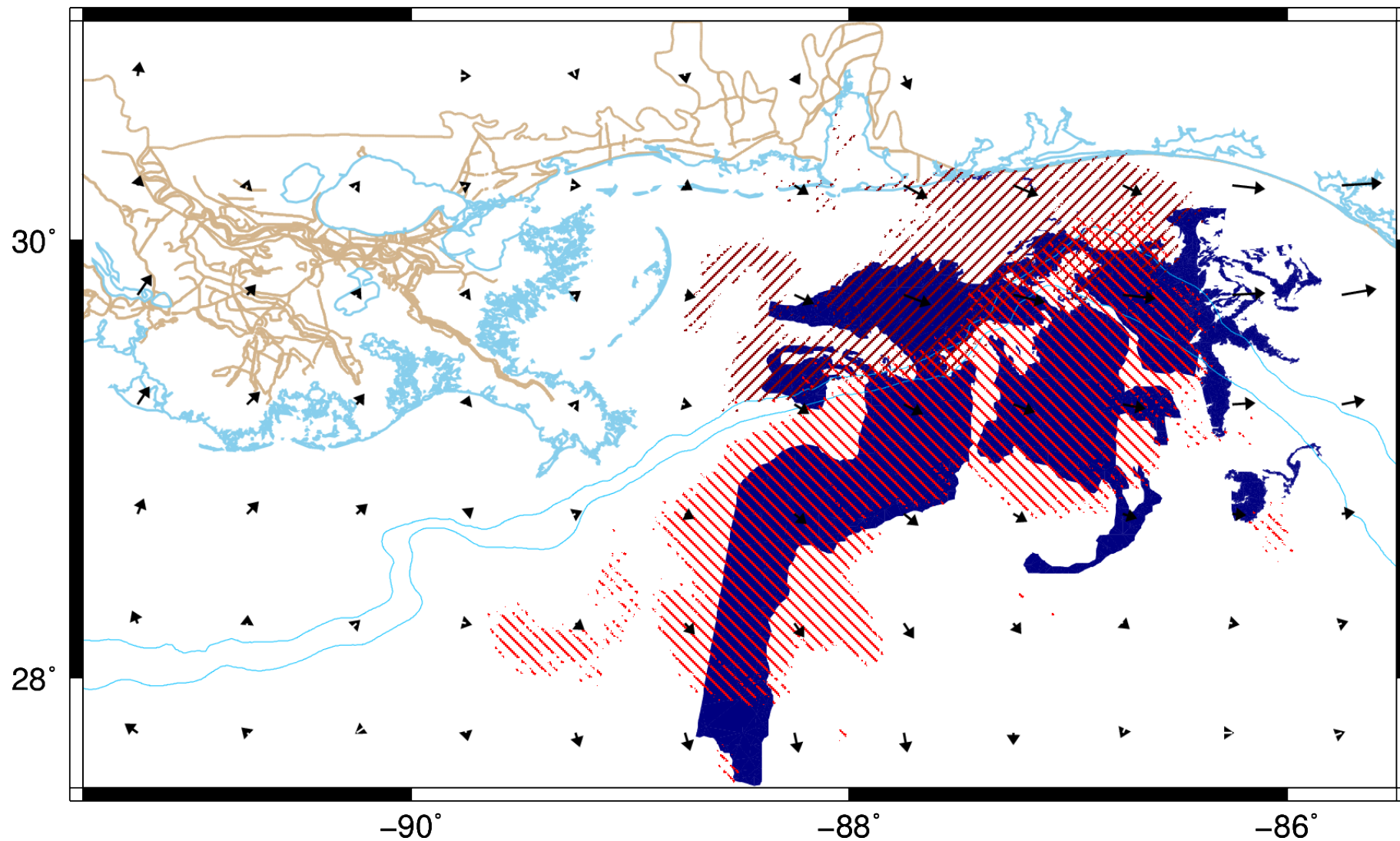


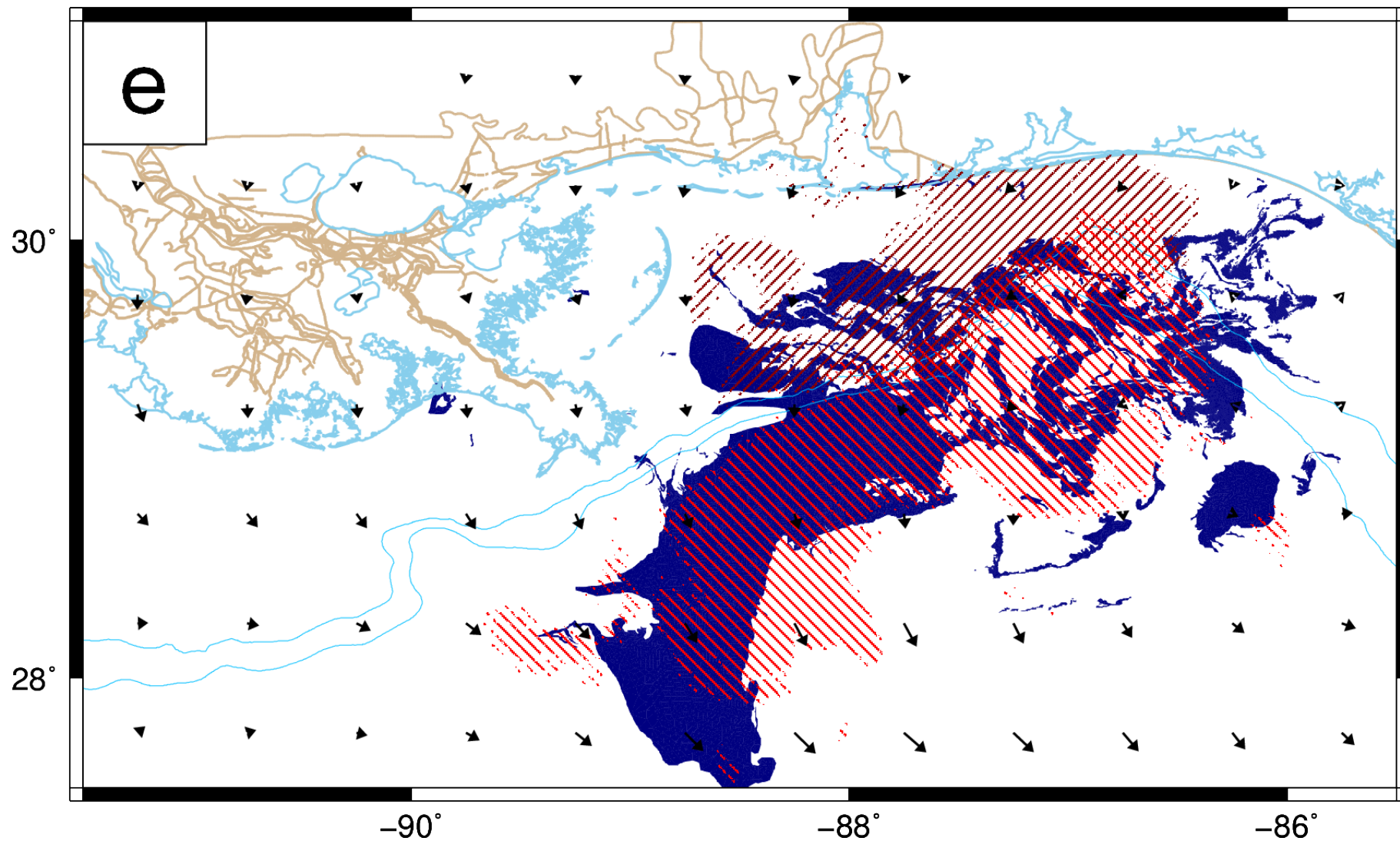
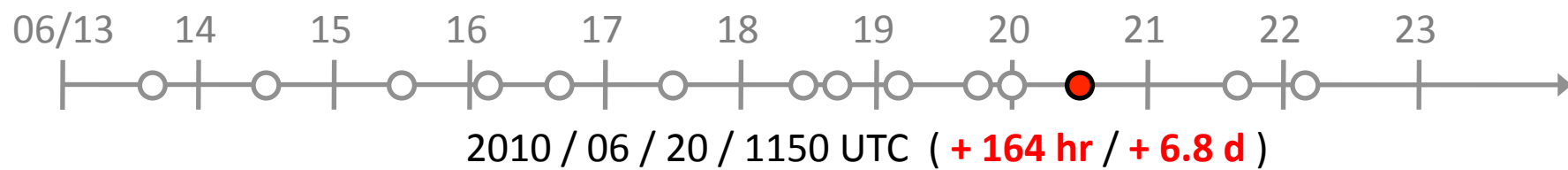


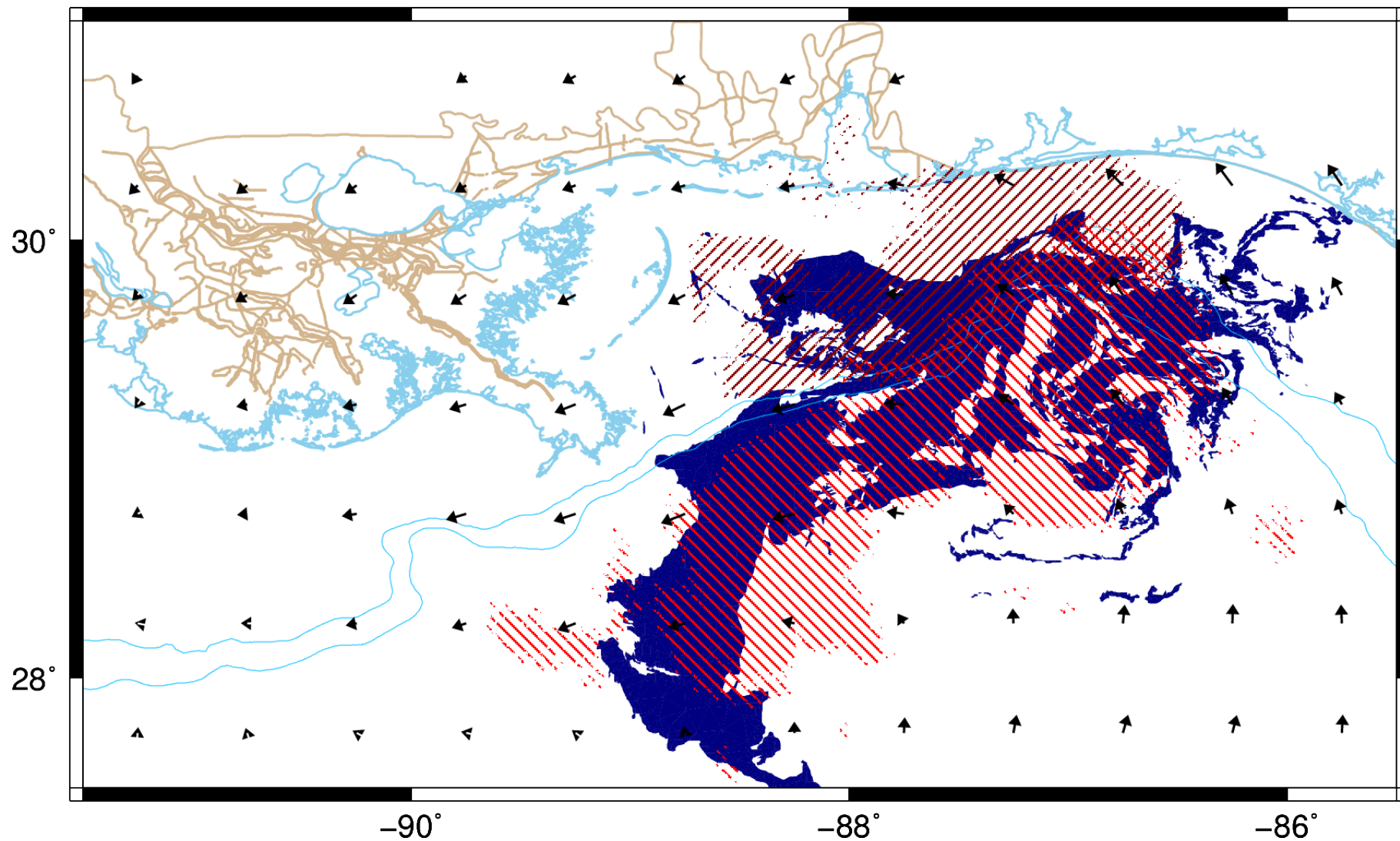
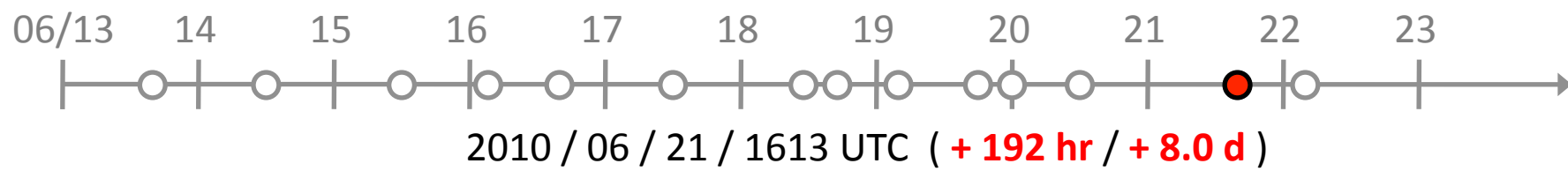


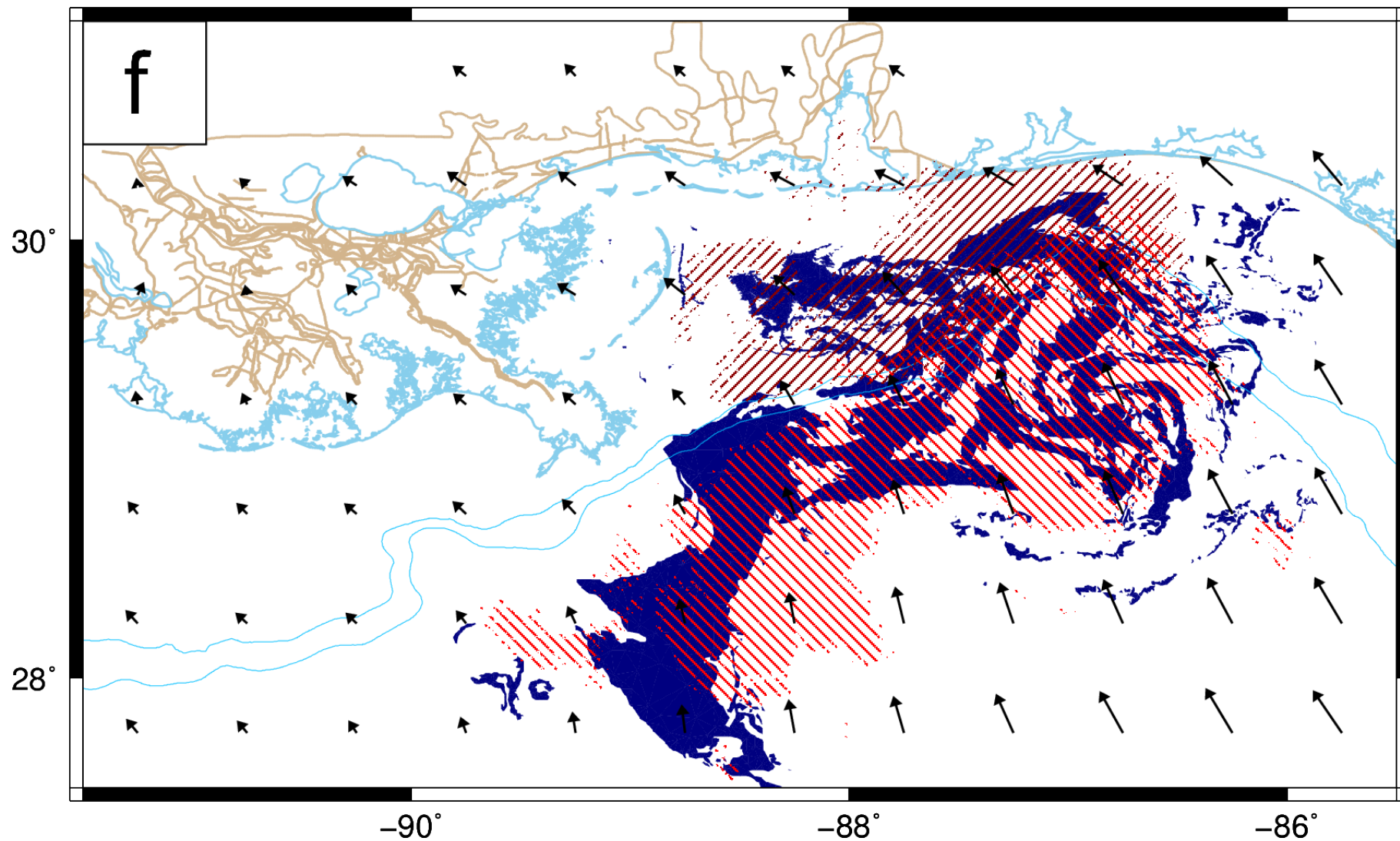
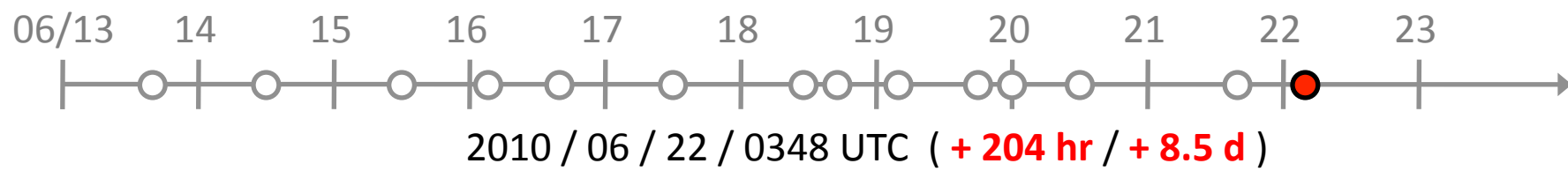


2010 / 06 / 19 / 2330 UTC (**+ 152 hr / + 6.3 d**)

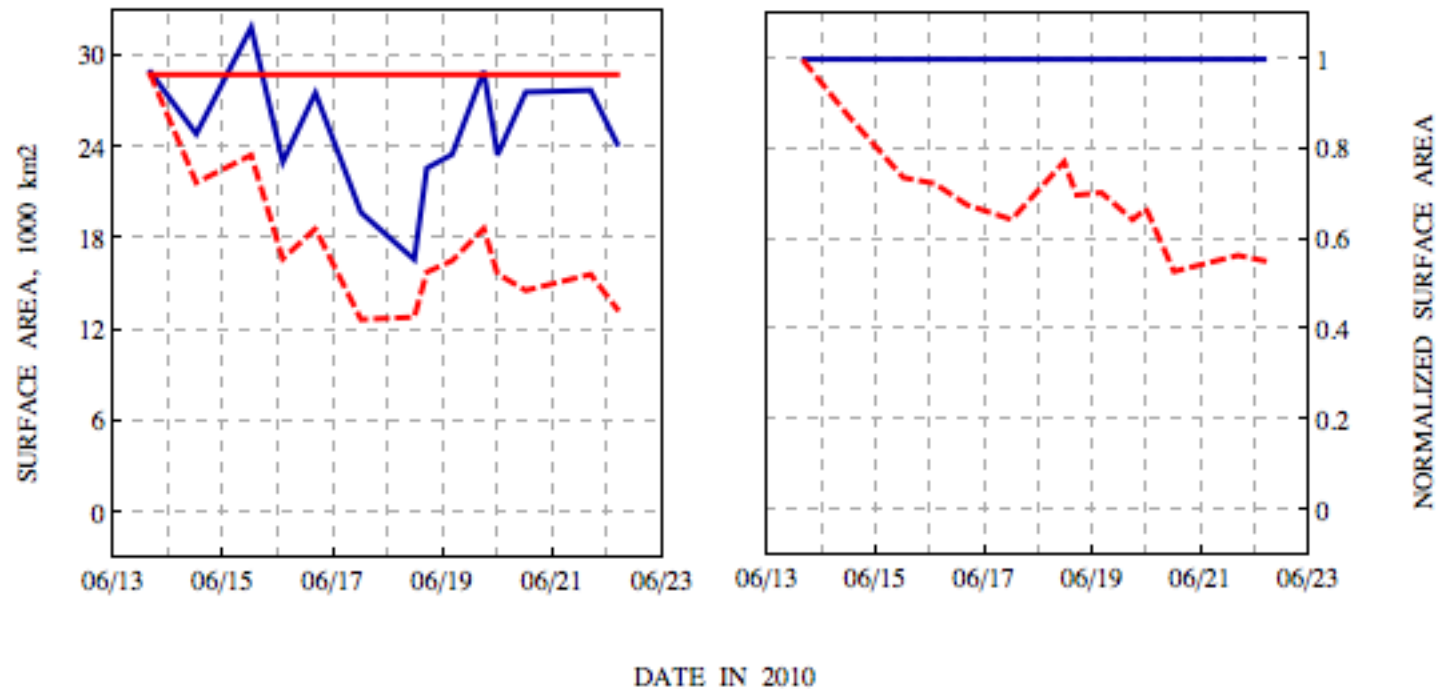








Validation : Mid-June : Computed Overlap



Overlap of our predictions to observations:

- Solid blue - Total areas of observed oil in satellite imagery
- Solid red - Total areas of predicted locations of Lagrangian particles
- Dashed red - Overlap between predictions and observations

After one week of simulation, overlap is about 60 percent

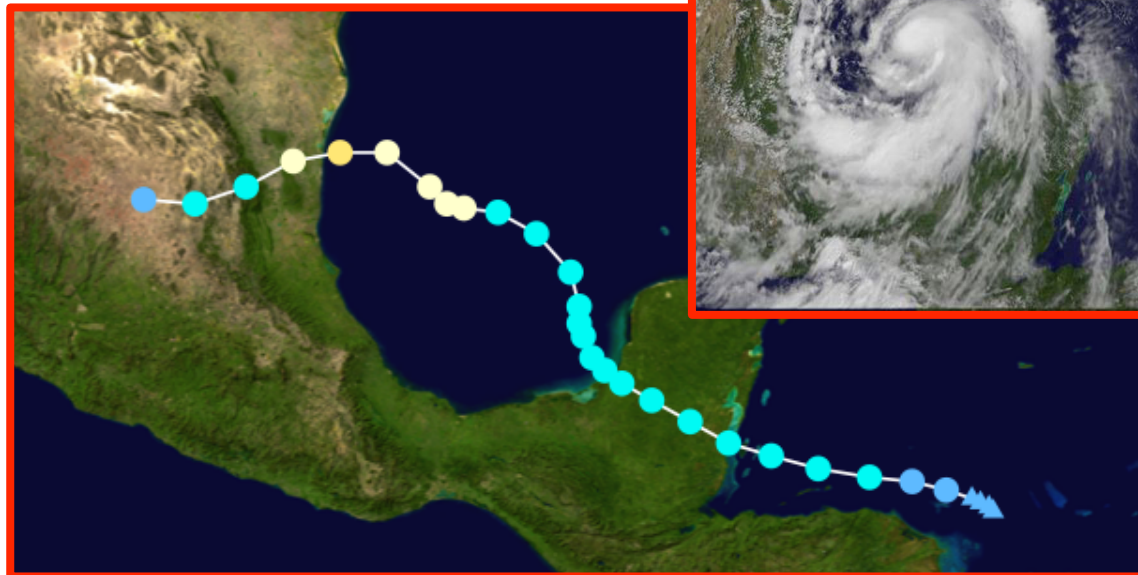
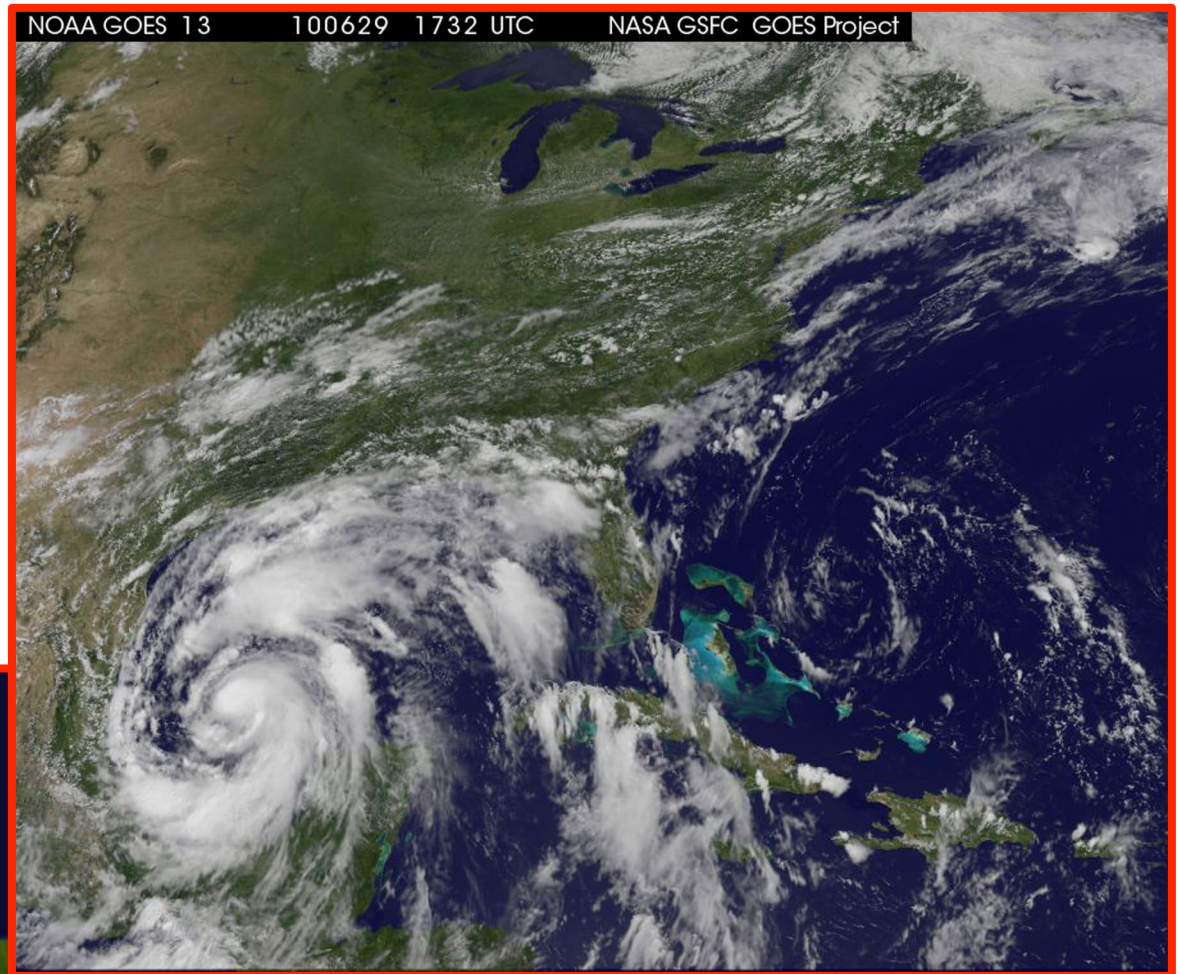
- Good qualitative and quantitative match to observations

Validation : Hurricane Alex (2010)

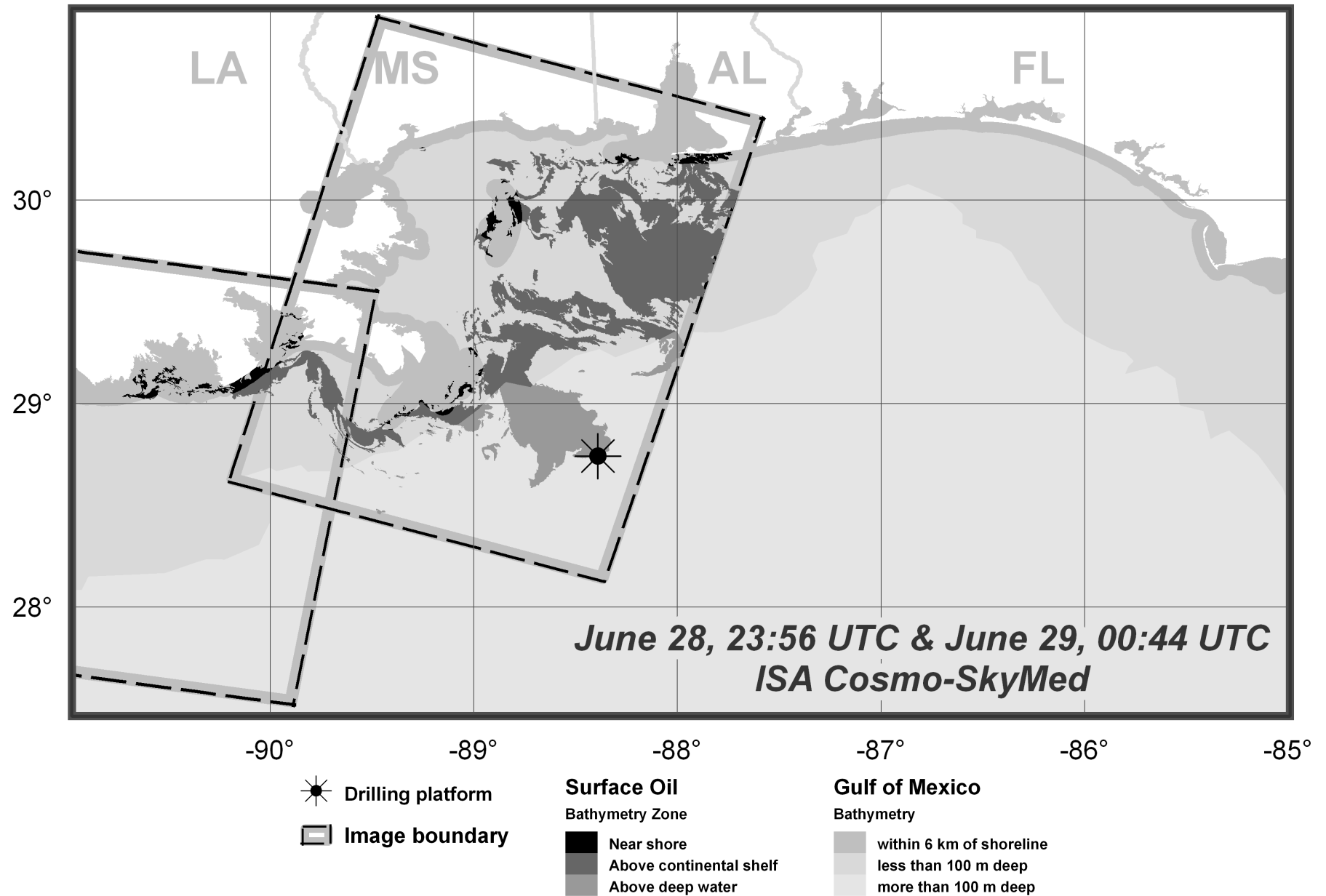
Made initial landfall in Belize
and tracked over Yucatan
Peninsula

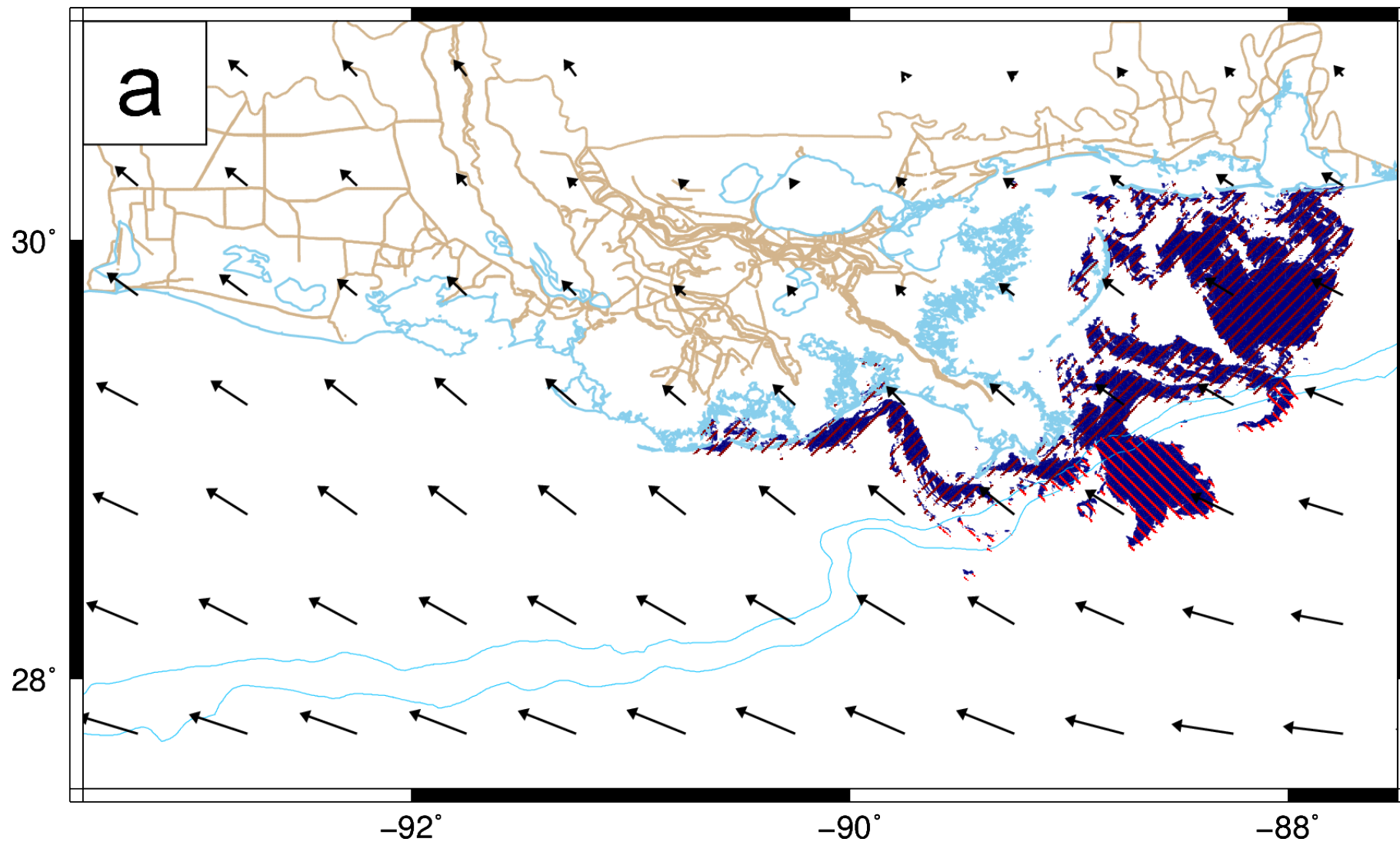
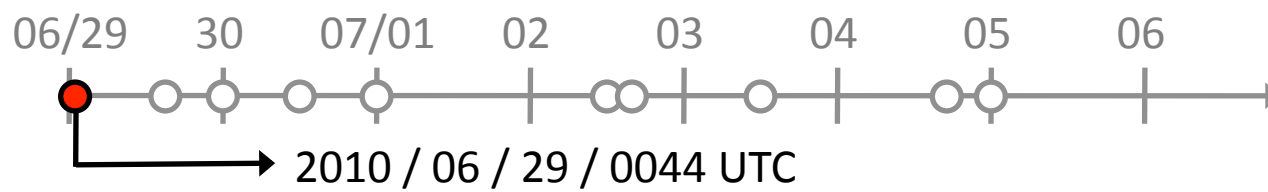
Strengthened in southern
Gulf of Mexico to
Category 2 storm before
making landfall in Mexico

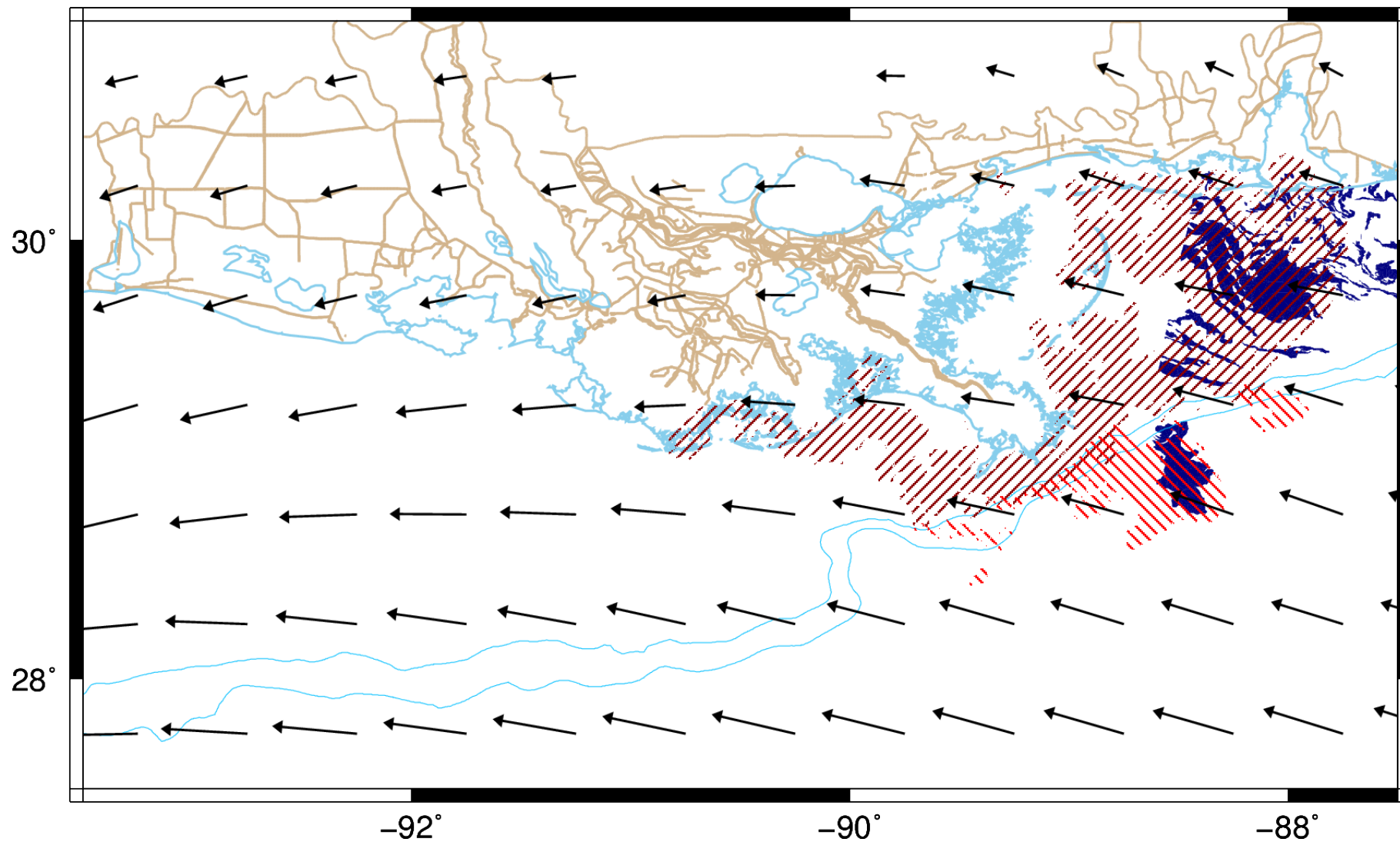
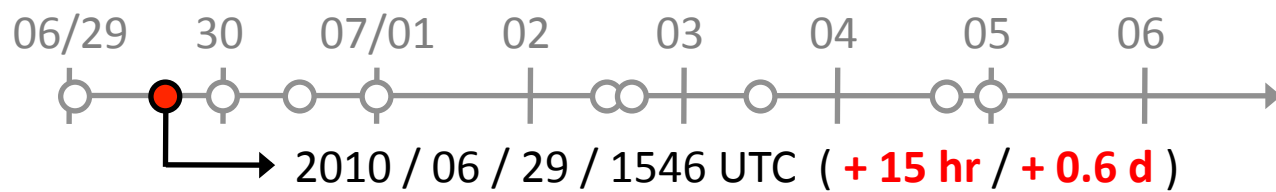
Available overhead imagery
was spotty in Gulf

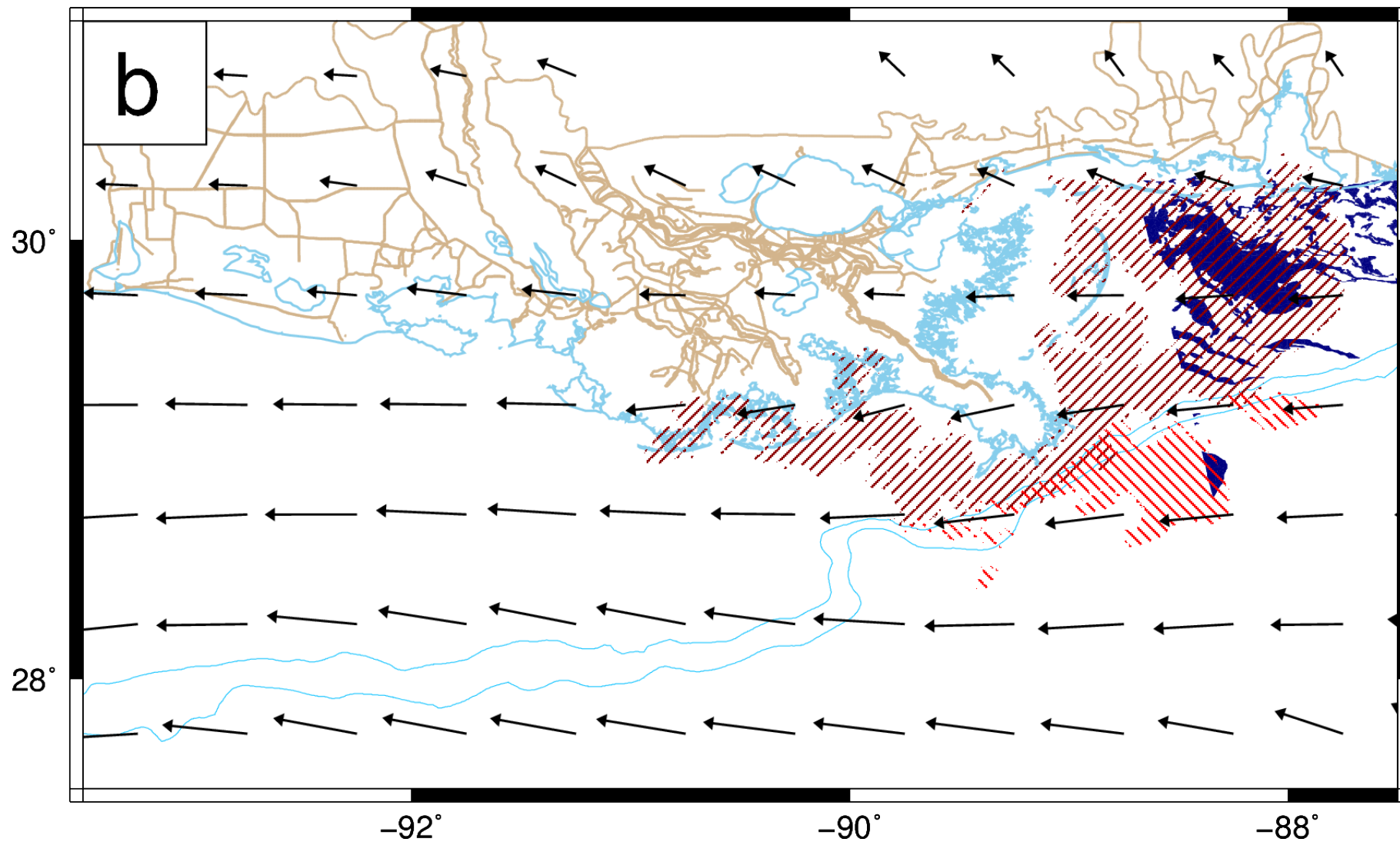
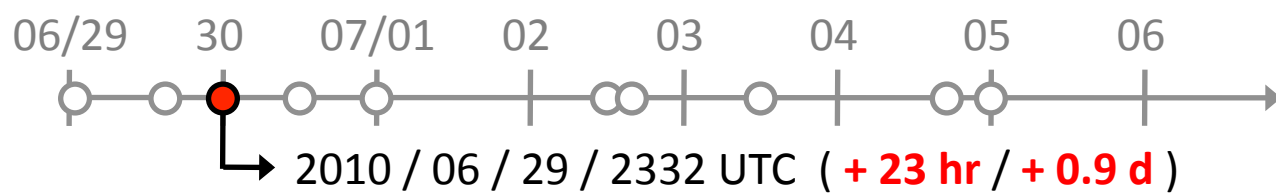


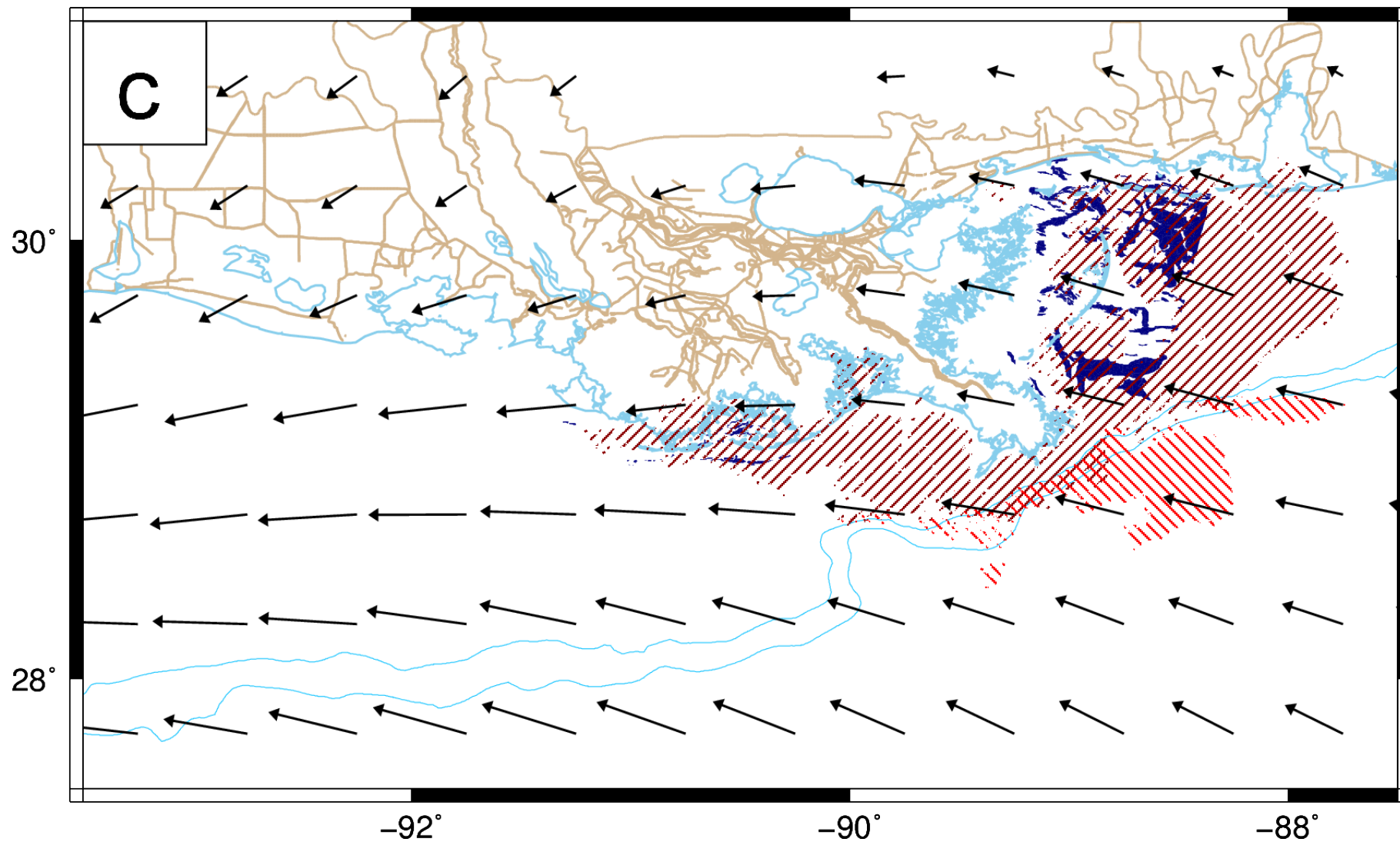
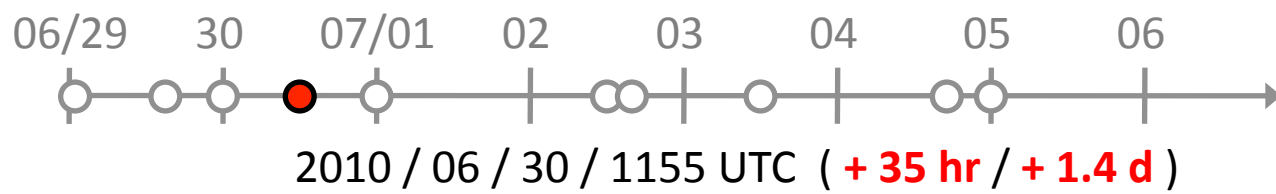
Validation : Hurricane Alex (2010)

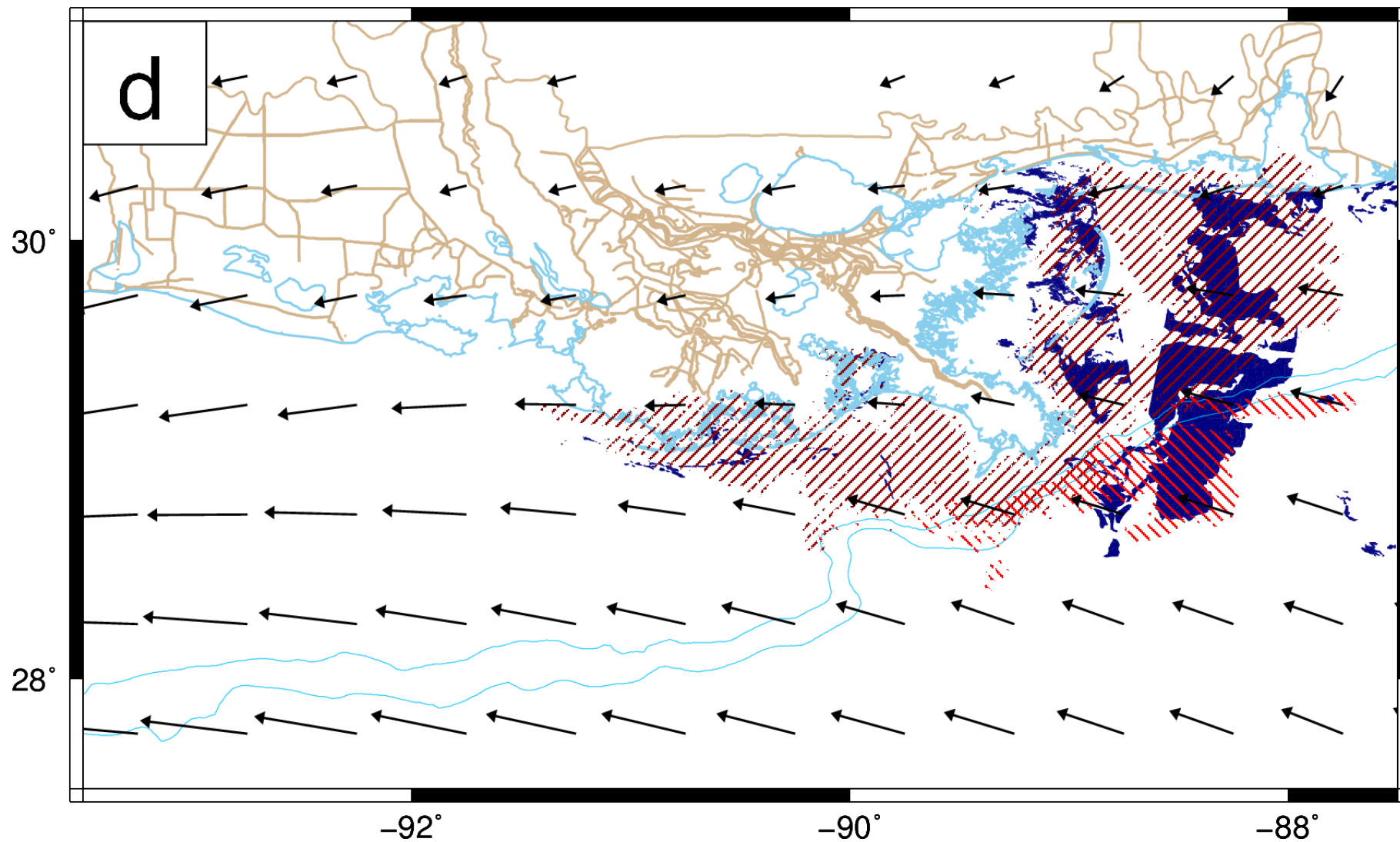
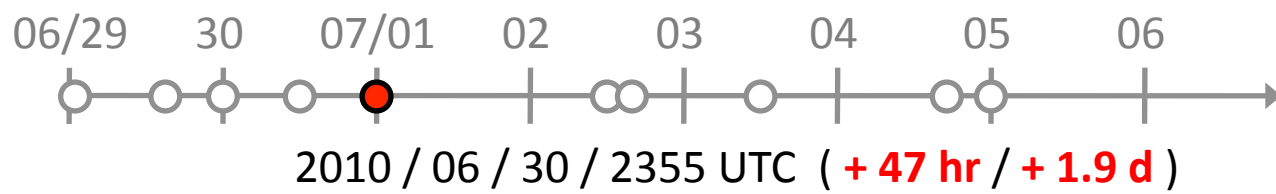






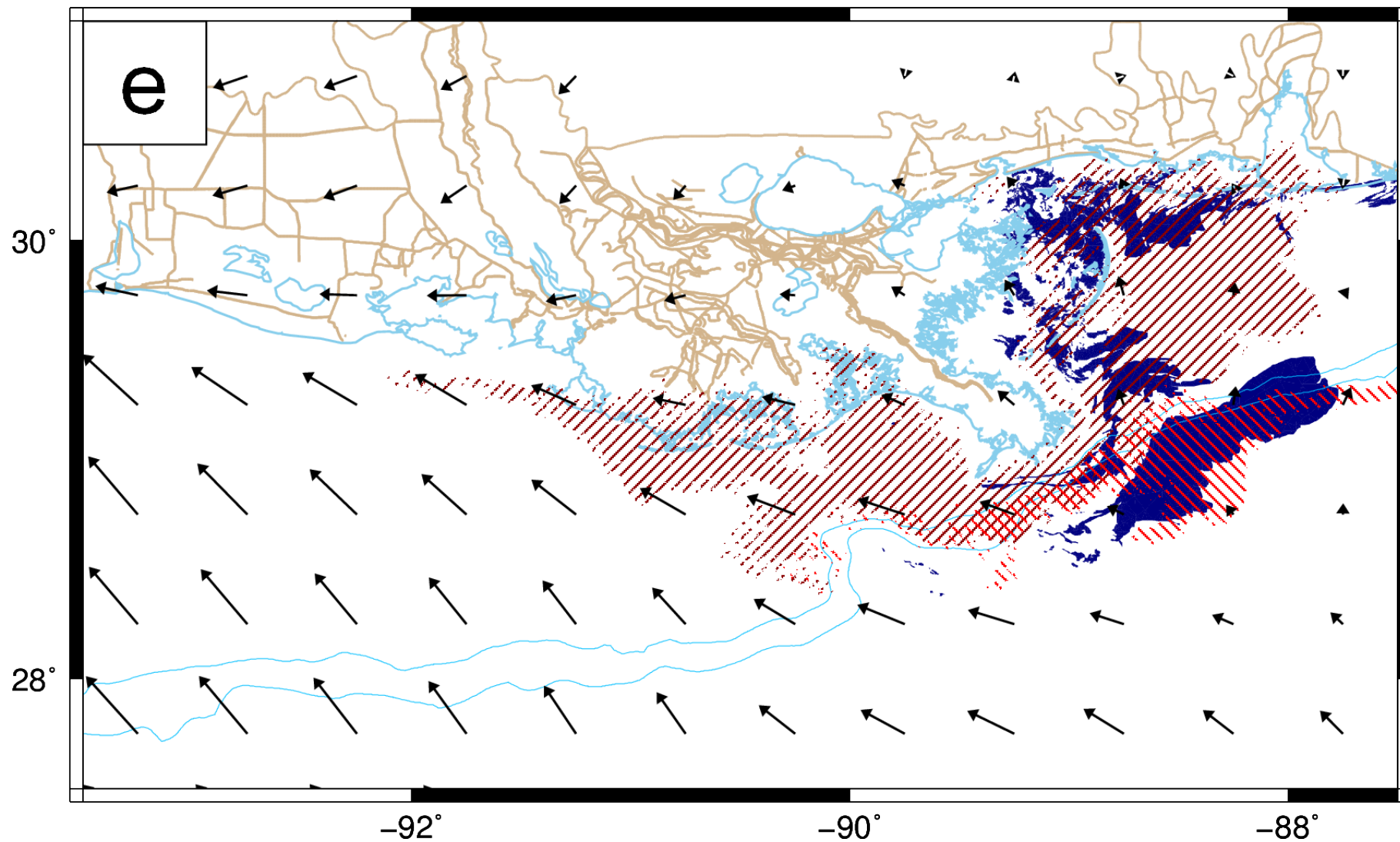


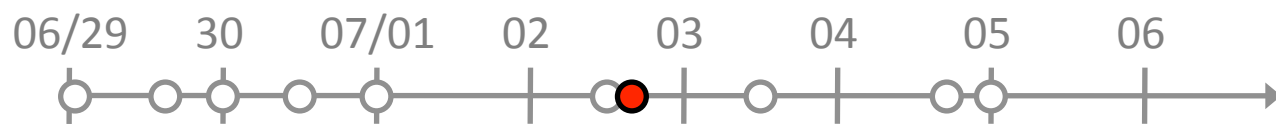




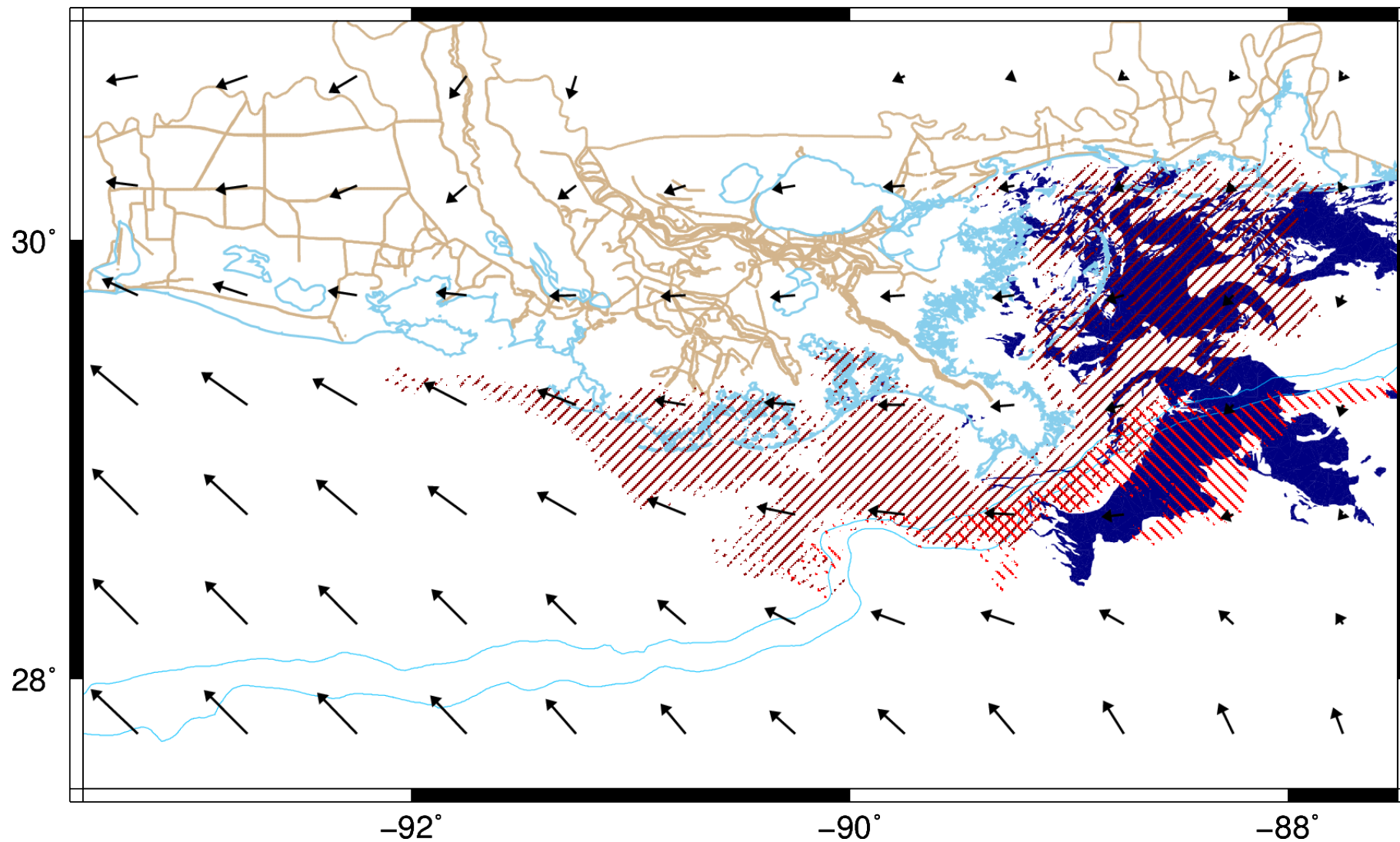


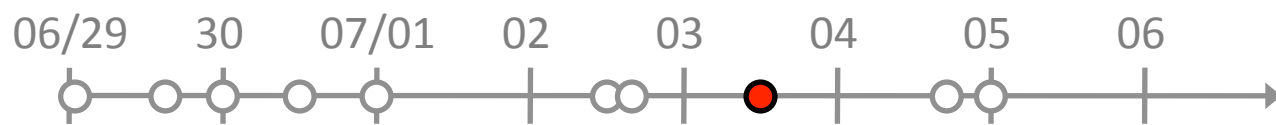
2010 / 07 / 02 / 1156 UTC (**+ 83 hr / + 3.4 d**)



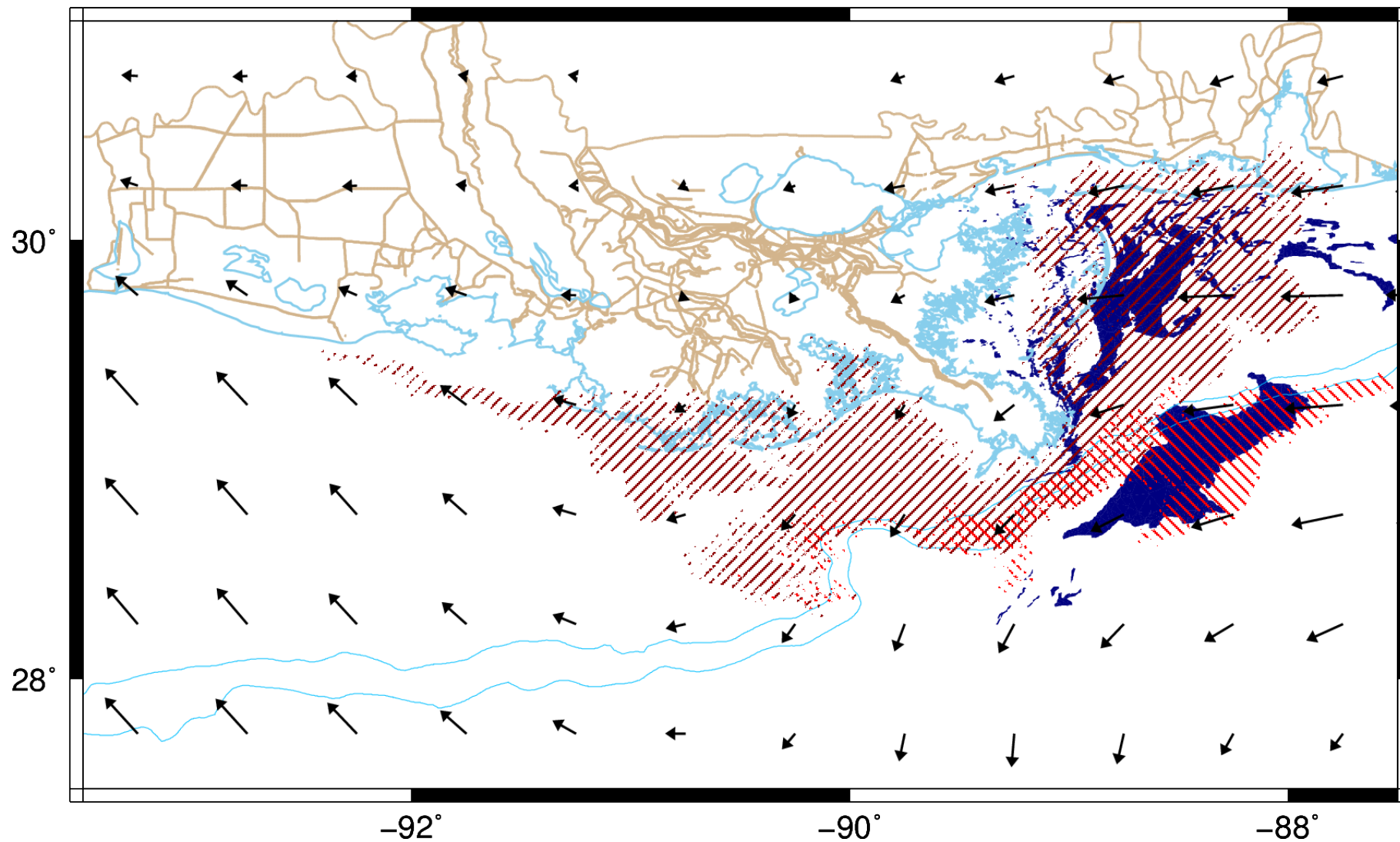


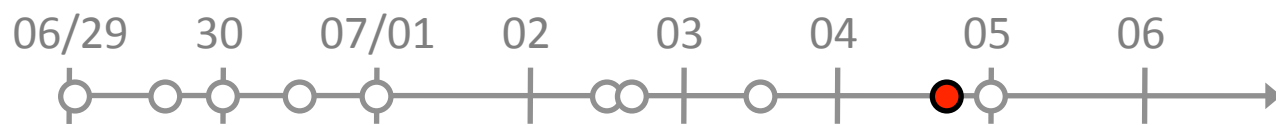
2010 / 07 / 02 / 1552 UTC (**+ 87 hr / + 3.6 d**)



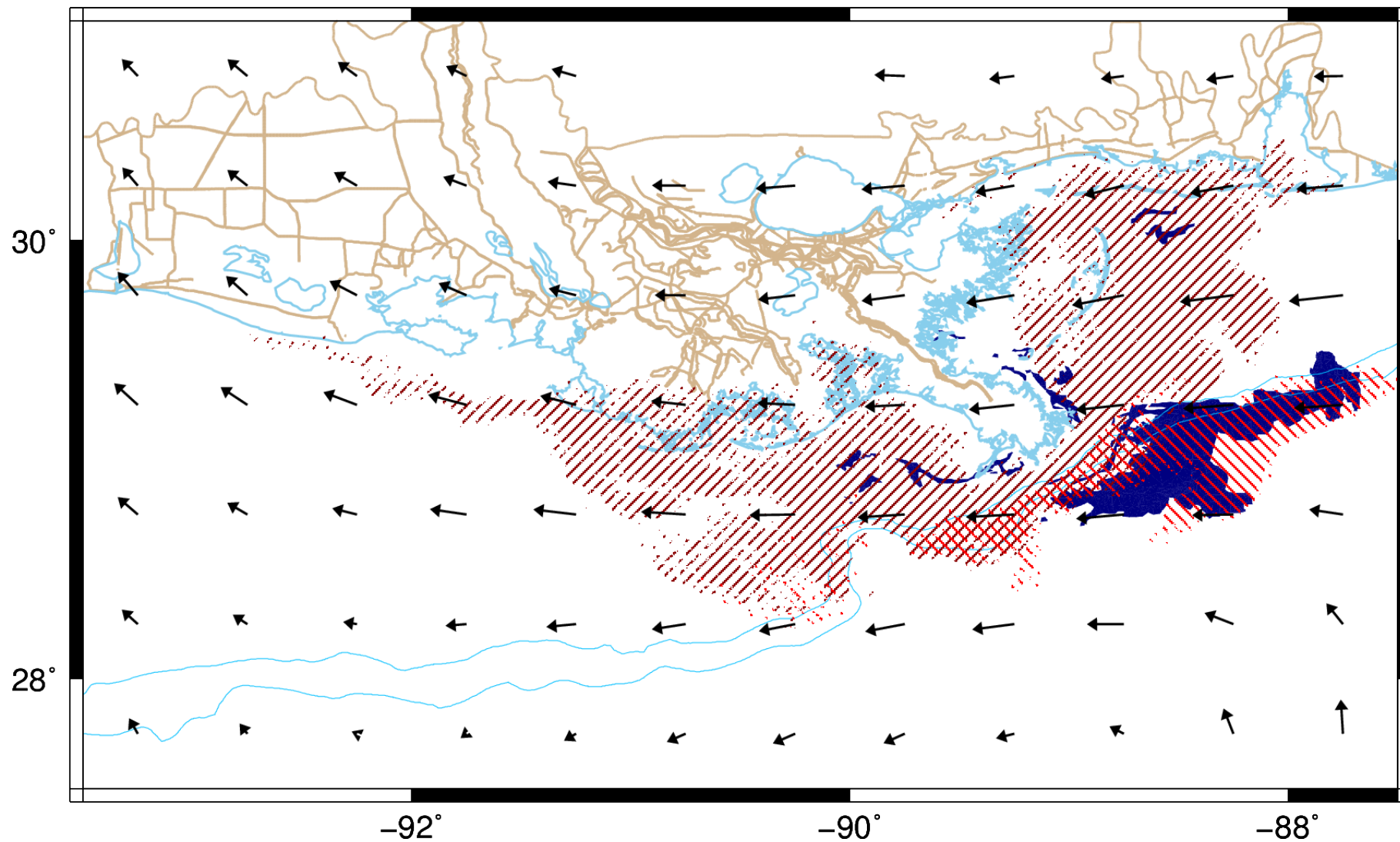


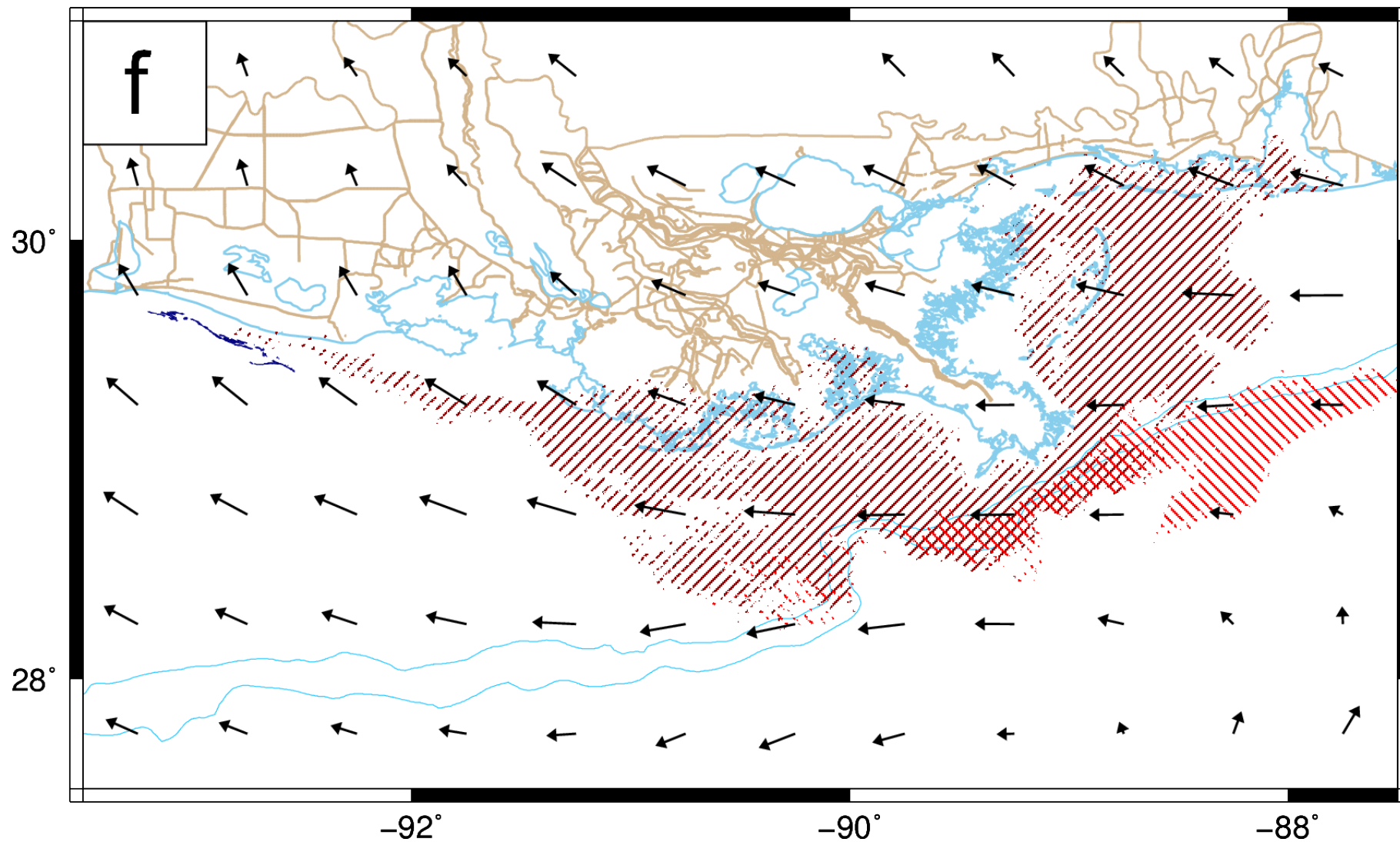
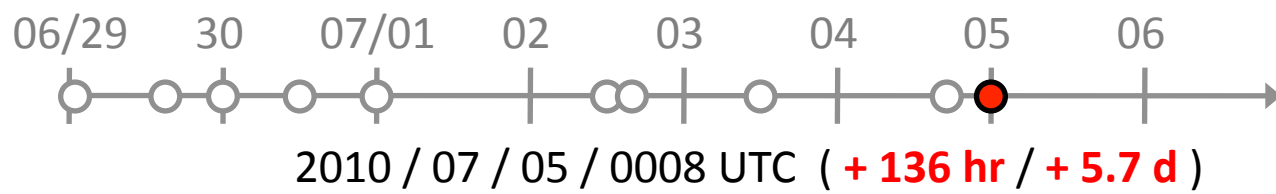
2010 / 07 / 03 / 1156 UTC (+ 107 hr / + 4.4 d)



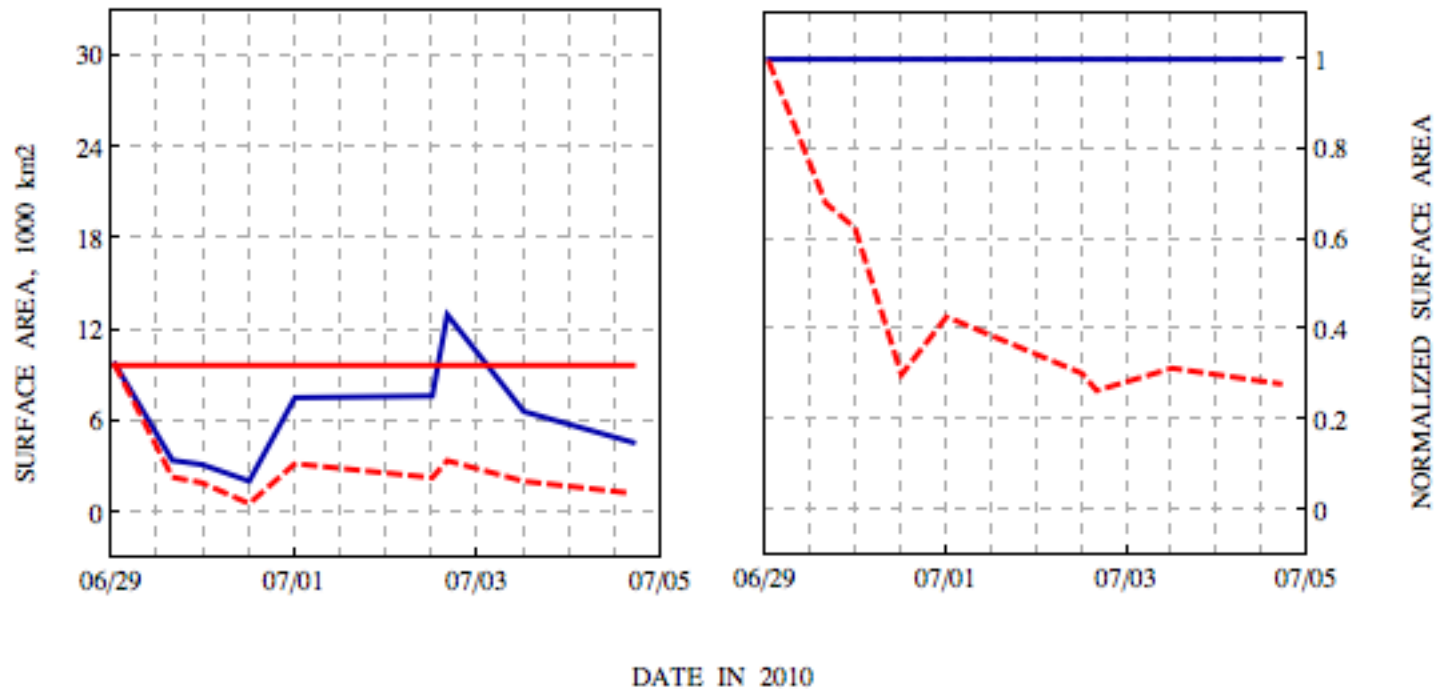


2010 / 07 / 04 / 1635 UTC (+ 136 hr / + 5.7 d)





Validation : Hurricane Alex (2010) : Computed Overlap



Overlap of our predictions to observations:

- **Solid blue** - Total areas of observed oil in satellite imagery
- **Solid red** - Total areas of predicted locations of Lagrangian particles
- **Dashed red** - Overlap between predictions and observations

After five days of simulation, overlap is about 30 percent

- Errors caused partly by spotty coverage in satellite imagery

Conclusions

Automated system runs successfully in real-time

Good match to overall movement of oil spill

- Small-scale features are modeled successfully

Validation is highly sensitive to quality of overhead imagery

Oil would have been influenced heavily by a hurricane in the region

- Movement into marshes of southern Louisiana
- Movement along the coastline toward Texas

